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Matching Mineral Resources to Future Needs

THE theme that by intelligent and vigorous planning mineral resources can be expanded into the far distant future was developed by Mr. Thomas B. Nolan, Director, Geological Survey, U.S. Department of the Interior, in a most stimulating address to the American Mining Congress at Seattle on September 11.

In defining mineral resources as naturally occurring materials that can yield a product which may be used by man, Mr. Nolan emphasised that in practice many people concerned with problems associated with natural resources overlooked the qualification that a resource was a useable substance. This oversight, he maintained, led to the misconception that resources are fixed in quantity and hence are exhaustible according to a predetermined schedule. It is, of course, true that the amount of a given material in the earth's crust is fixed. On the other hand, such questions as which materials are usable at any time, thus constituting mineral resources, and in what quantities, depend on what man's knowledge makes it possible for him to use to his advantage at that particular time. For example, the material of critical value to Stone Age man was flint, and if a Stone Age economist had surveyed the mineral resources of his world, he would not have thought of listing most of the several hundred rocks and minerals used today.

On these grounds, Mr. Nolan maintains that resources are literally created by man through research that develops new uses for raw materials, that permits the recovery of ores of lower quality than were previously mineable, and that makes it possible to discover concealed deposits of used materials. Rather than exhausting his natural resources by profligate use, as is so often claimed, man has created resources as his knowledge has advanced and he is still doing so today.

To illustrate this point, it was recalled that only a few years ago our resources of energy were thought to be known quantities, exhaustible in a few hundred or, at most, a few thousand years. The discovery of fission, however, created an entirely new source of energy from uranium, while the development of fusion will probably create another one from deuterium and other light elements. The breeder reaction, making possible the use of thorium and uranium 238 as well as uranium 235, is likely to be perfected in the near future. Assuming they will be used in the breeder reaction, the known U.S. reserves of uranium and thorium in domestic ores mineable at current prices contain between two and ten times as much energy as the entire U.S. coal reserve. Moreover, as little as 100 p.p.m. of uranium is now being recovered economically from phosphate rock as a by-product of the manufacture of triple superphosphate. Hence it is safe to assume that progressively lower grade uranium ores will soon come within reach. As this happens, energy resources will increase many times further, since several common rocks—phosphate rock, black shale and alkalic granites, for example—contain 50 p.p.m. of combined uranium and thorium. Here, then, is a tremendous potential resource which has been created by research.

In considering what kind of research must be done to develop supplies of raw materials for the future, Mr. Nolan concludes that

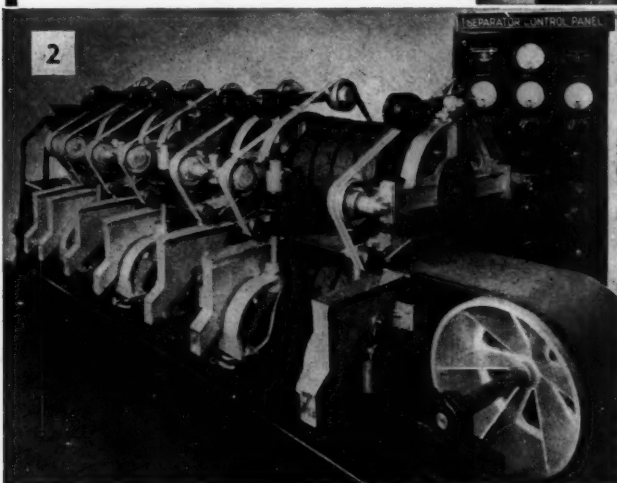
ONE WAY AND ANOTHER...

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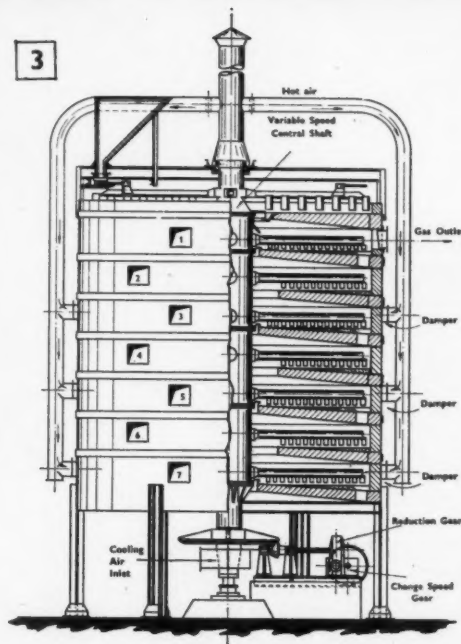
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three general categories are desirable: (1) research that will develop new applications for raw materials currently in use, or that will call for the utilisation of materials at present little used for any purpose; (2) research that will make it possible to extract valuable materials from deposits that cannot be mined or processed economically now; and (3) research that will allow us to predict the location and nature of deposits that do not outcrop, or are concealed by surficial deposits.

Of these three categories of research, the first has probably done the most to open new possibilities of economic growth and to raise man's level of living. Nearly all the terms used to signify the different periods of man's development—the Stone Age, the Bronze Age, the Coal Age, the Iron Age, the Nuclear Age—reflect the utilisation of raw materials that were previously valueless but whose newly-discovered use materially changed man's standard of living. Mr. Nolan believes that similar discoveries will continue to take place at an ever accelerating rate, in which connection he instances the explosive growth currently being seen in the use of a dozen or so elements hardly known outside the chemical laboratory a few years ago—beryllium, columbium, selenium, tellurium and germanium are just a few of the currently "hot" elements for which highly specialised uses are developing.

Progress in the second category of research, directed at the extraction of minerals from deposits that cannot be mined or processed economically now, has also been impressive if, perhaps, less spectacular. It is this type of research, for example, that has made it possible for the United States to use its taconites and thus create such a tremendous resource of iron ore that its total reserves of mineable iron ores stand higher now than ever before. Since the tonnage of any element in high-grade ores is small compared to that in low-grade ores, there is no doubt that we will depend more and more on low-grade sources as time goes on. Development of the technology necessary to utilise progressively lower grade ores will make bountiful supplies of raw materials available to mankind.

In the same category is the problem of finding ways to mine coal, oil and other minerals without leaving half or more of each deposit in the ground. In this connection the interesting comment is made that the present practice of reporting reserves of these minerals in terms of the tonnages that known technology permits us to extract from the ground, makes us lose sight of half of the apple that ought to be drawing us into more research on improved methods of extraction.

On the subject of by-product recovery, the view was expressed that the processing of many low-grade ores should be viewed as a co-product operation in which all of the usable materials are recovered, a notable example of such an operation being the treatment of the Cambrian "alum shale" in Sweden. As described to Mr. Nolan several years ago, 5 and 2 per cent by weight of this black shale were recovered as oil and sulphur respectively; an additional 5 per cent in oil equivalent was recovered as gas and heat; the remainder was then processed to make building materials and somewhere in the process about 0.4 per cent of vanadium was also recovered. If the "alum shale" has a composition similar to that of some other black shales, it may also contain significant amounts of selenium, zinc, nickel and molybdenum.

Mr. Nolan is convinced that research on mining and metallurgical technology ought to receive far more support from both industry and government than is the case now in the United States (and how much more so in other Free World countries, including Britain!). Whereas in America an average of about 4 per cent of the sales value of the products of other industries is spent on research, the comparable figure for the mining industry is less than 1 per cent.

In the third category of research a similar position exists; progress in the science of ore finding is measurable but insufficient to solve many of the problems facing us. Of these, problems, three are most pressing in terms of future demands: the first and most difficult is: how can we discover the ore deposits that surely exist beneath the earth's surface but are wholly concealed? The second is: what are the origin, habits and probable extent of the deposits of the "new" elements—tellurium, selenium and others that, having had little value in the past, have received so little attention that we hardly know how to go about prospecting for them? Thirdly, what are the habits, the nature, and the characteristic environments of the low-grade deposits?

Excellent strides have been made in developing methods and principles applicable to the search for concealed deposits of oil and gas, and the development of instruments such as the airborne magnetometer and airborne radiation detector has made it possible to search more effectively for wholly concealed deposits of a few other minerals. Moreover, study of the genesis and habits of ores in specific districts has led to much success in searching for blind ore bodies in adjacent areas. Based on the ratio between exposed and concealed areas, it is commonly assumed that there are at least two or three times as many deposits yet to be found as have been discovered so far. For many minerals, however, we do not yet have the knowledge that permits us to search effectively for concealed deposits beyond the limits of known areas of mineralisation or beneath extensive cover. Mr. Nolan doubts whether any solution will be found that does not depend on a clear understanding of the origin and habits of ore minerals, combined with accurate knowledge of aerial geology.

As for the scope for further discoveries, even in such an advanced mining country as the United States, petroleum geologists estimate that cumulative production and proved reserves of oil are about a sixth of the total believed to be present in the ground, and cumulative production alone is about one-ninth of this. On the basis that exploration for petroleum is a good deal more advanced than that for most other minerals, it seems reasonable to assume that the value of undiscovered mineral deposits other than that of the fossil fuels is at least ten times that of the production to date, giving a target of roughly a trillion (a million million) dollars in concealed deposits. In the United States alone such is the value of the resource that might be created by improved methods of ore finding!

RUSSIAN EXPERTS IN CUBA

When Freeport Sulphur Company explored the Moa Bay region of Cuba and established large ore bodies of nickel and cobalt just after the outbreak of the Korean War, their answer to the problem of treating the lateritic ore, averaging 1.35 per cent nickel, 0.14 per cent cobalt and 46.5 per cent iron, was no easy solution. Eventually, it resulted in the construction of a \$45,000,000 refinery in Louisiana, U.S.A., for the separation of nickel and cobalt from concentrates shipped from Moa Bay where they had been chemically beneficiated by sulphuric acid leaching. Cuban nationalism aborted the project and the Russians came in to try their hand.

Mining engineers and their colleagues associated with the American venture will be intrigued by the latest report published by the *Soviet News* that Leningrad experts have begun to prepare blueprints for a group of new shops for the Moa Bay nickel plant, which says: "With the building of this project the Cubans will be able for the first time to obtain metallic nickel and cobalt from their own ore."



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Apparently the new shops which will be equipped by Soviet engineering enterprises are to be completed by 1962.

Already, say the Russians, the technical drawings for the first shop which will prepare sulphide concentrates for processing into metallic nickel and cobalt have been completed ahead of schedule and are shortly to be submitted to the Cuban government. Unlike the Americans, who preferred to bring sulphur to Moa Bay from the U.S., the Russian technological scheme is to provide for the simultaneous extraction from the sulphides of the sulphur necessary for the primary processing of nickel ore. In 1963 the Russian experts will complete the technical drawings for what is described as an absolutely new nickel plant for Cuba under contracts already signed by the two governments. No mention is made, however, of the likely capacity of the new plant. Freeport Sulphur's refinery at Louisiana was planned to produce 25,000 s.tons of nickel and 2,200 s.tons of cobalt a year from Cuban ore.

Quite apart from the political considerations involved in establishing a Cuban nickel industry, the Russians are expected to be in the world market for the metal on a substantial scale for some years to come, therefore they have a keen economic incentive anyhow to try to solve the problems of treating the difficult and complex lateritic ores.

While the Freeport plant has been idle since its seizure two years ago by the Castro regime, the American government-owned \$85,000,000 Nicaro nickel processing plant, confiscated at the same time, has been maintained in operation except for one serious breakdown when one of the main stacks was blown. Currently, the plant is being operated at about two-thirds of its 27,500 s.tons capacity with the technical assistance of communist experts from Czechoslovakia. To repair and maintain the plant some items of equipment have been imported from behind the Iron Curtain, others have been obtained by "cannibalising", in part, the Moa Bay plant.

Now, reports *The Northern Miner*, the U.S. government is considering whether or not to sue the Cuban government before the International Court of Justice in the Hague for compensation in respect of the confiscation of Nicaro. This would certainly be an interesting action to follow, especially as the current president is a judge from Poland.

INDIAN COAL PRIORITIES

The National Coal Development Corporation of India (N.C.D.C.) has finally decided to concentrate on raising output in the Madhya Pradesh and Maharashtra coal areas during the Third Five Year Plan and not in the Bengal and Bihar coalfields as was previously intended.

This was revealed by Mr. R. C. Dutta, managing director of the N.C.D.C., in a recent interview at Ranchi. The revised priority has been decided upon because of transport difficulties in Bihar and Bengal where there has been considerable congestion in industrial goods traffic.

To reach its overall target of 30,500,000 tons of coal at the end of the Third Plan the Corporation will require an additional output of 17,000,000 tons annually. In its allocation of the target quota for additional output the N.C.D.C. is planning to raise 9,000,000 tons from Madhya Pradesh, 4,000,000 tons from Bihar, 3,000,000 tons from Maharashtra and 2,000,000 tons from Orissa.

Mr. Dutta said the Corporation would raise only good coking coal from Bihar and from the West Bengal mines at Jharia, from the mines at West Bokaro and elsewhere. He

added that about half a dozen washeries would be built by the Corporation: one would be in Kathara in two units, each having a capacity of 3,000,000 tons, another would be in Karanpura with 3,000,000 tons capacity and another at Ramgarh with 1,500,000 tons capacity. Yet another washery would be started at Saudamdih though not necessarily during the course of the Third Plan. A washery for coking coal might also be constructed in Madhya Pradesh.

Turning to the question of increased mechanisation, Mr. Dutta felt that some difficulties might be experienced with new types of machinery. He went on to say that the Corporation might undertake four new projects in collaboration with representatives of foreign organisations.

In connection with technical assistance of this sort which has been arranged on an inter-governmental level, Mr. J. W. Elliott, who has been deputy director general of reconstruction of the British National Coal Board, is already in Ranchi where he will be for some considerable time on secondment to the N.C.D.C. During the course of the next few months he will be joined by the rest of a British team which will include mining, mechanical and electrical engineers, a specialist in opencast mining, geologists, surveyors and other experts.

Mr. Dutta said that agreements for technical assistance had been reached with Poland for experts to collaborate at the mines at Saudamdih. Furthermore, an American team might arrive in November, for drafting a project concerning the Ramgarh mines, and a Russian team was expected to work on projects in two underground mines at Korba.

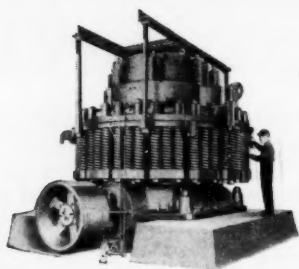
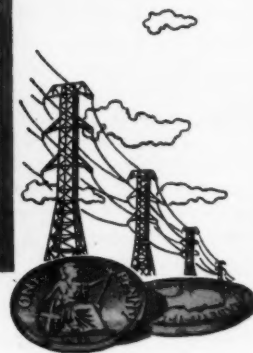
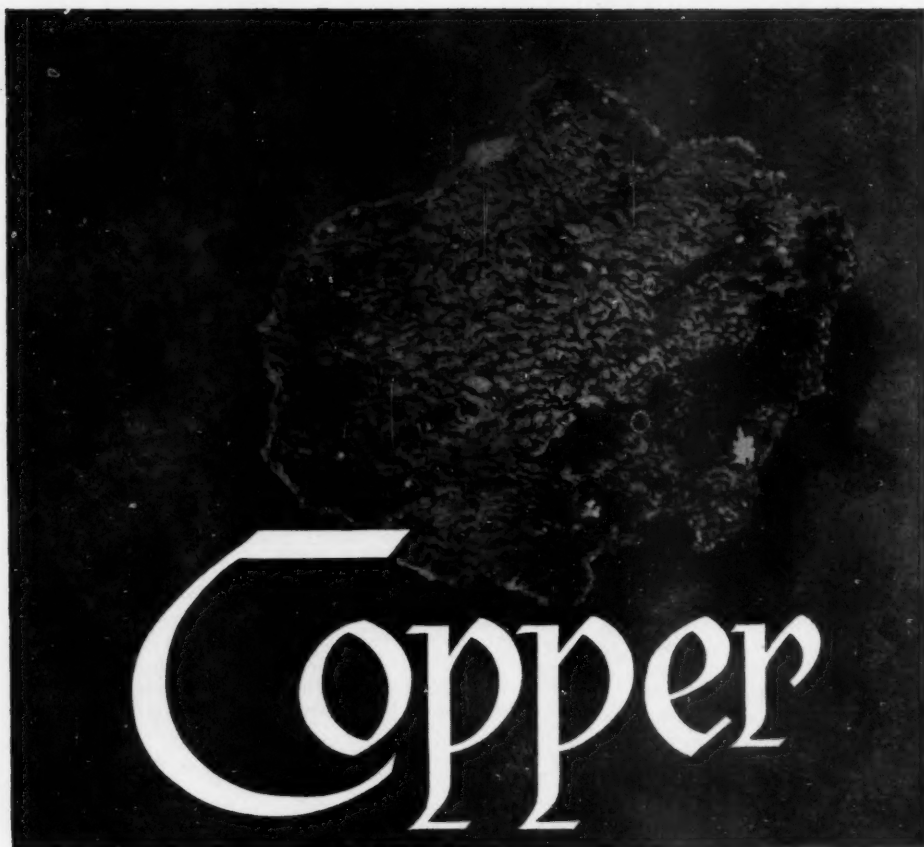
WATER IN COPPER MINING

More water is used to produce a ton of copper, on the average, than to produce a ton of any other major metal, states the U.S. Department of the Interior in Geological Survey Water-Supply Paper 1330-E "Water Requirements of the Copper Industry".

During the period of the study the U.S. copper industry used about 330,000,000 gallons of water per day in the mining and manufacturing of primary copper—some 0.3 per cent of the total estimated withdrawals of industrial water in the United States for that year. The report is limited to a study of water used in mining the ores and reducing domestic and imported ores and intermediates to refined copper. It does not include subsequent processing or fabrication.

The survey upon which this publication is based was one of a series on water requirements of selected industries. These surveys have been made in order that new industrial plants can be sited near adequate supplies of water of suitable quality without infringing on the requirements of established industries.

It was found that a little more than 100,000 gallons of water was used in the production of a ton of copper from domestic ores. Of this amount about 70,000 gallons per ton was used in mining and concentrating the ore, and about 30,000 gallons per ton was used to reduce the concentrate to refined copper. In areas where water was scarce or expensive, the unit water use was a little more than half the average. About 60,000,000 gallons per day or 18 per cent of the water was used and not recovered. Nearly all of the consumptive use occurred in the water-short areas of the West. Of the water used in mining and manufacturing primary copper (75 per cent was surface water and 25 per cent ground water), 89 per cent was self-supplied by the copper companies and 11 per cent came from public supplies.



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The name *copper* is from the Greek *kypros*, Cyprus, one of the early sources of the metal. Copper has often been called "the common man's gold"—and has become a symbol of *money* due to its wide usage in the coins of many nations, as well as a symbol of *power*—since the greatest usage of copper has been as a conductor of electricity.

While native copper is the only metal found abundantly in nature, commercial production is supplied chiefly from various ores of copper, including chalcopyrite, chalcocite, cuprite and malachite.

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The Overburden Drilling Method

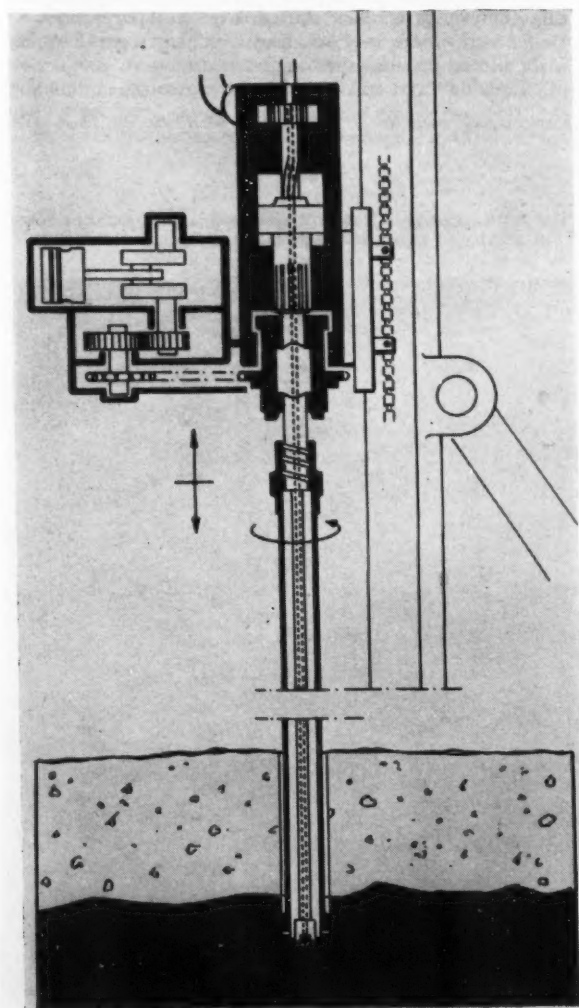
THE Overburden Drilling Method is the name of a new technique whereby drilling is carried out through subsoil and boulders, also under water, to and through bedrock, at faster penetration rates and much more economically than ever before. Developed by Scandinavia's biggest contractor, A.B. Skånska Cementgjuteriet, in co-operation with Atlas Copco and Sandvik Steel Works, the Overburden Drilling Method was introduced on the Lindö Canal project at Norrköping on Sweden's Baltic coast.

The first results on the Lindö Canal were encouraging and revealed that faster penetration rates were gained at considerably reduced cost. It was seen, also, that this new drilling technique was flexible and could be applied to a number of allied tasks. The method has been used with success in Sweden for the past two years.

Atlas Copco has secured the sole rights for exploiting the Overburden Drilling Method outside Scandinavia.

The Method

The Overburden Drilling Method (OD Method) requires special equipment, consisting of Atlas Copco rock drills with



powerful, independent rotation, chain feeds and Sandvik Coromant special drill pipes and standard extension steels. High pressure water flushing contributes to a fast penetration rate.

All kinds of overburden are easily penetrated with this type of equipment. Boulders, hard moraine, etc., are drilled without difficulties. The drill pipes are joined together with external coupling sleeves. The first pipe down the hole has a detachable ring bit. Inserted in the drill pipes are Sandvik Coromant standard 1½ in. round extension steels, the leading steel having a tungsten carbide tipped cross bit which projects 1 in. beyond the ring bit and acts as a pilot.

The drill pipes and the extension steels inside are drilled simultaneously through overburden including boulders. The percussive force from the rock drill is transmitted by a special shank adapter to the extension rods and drill pipes. The powerful torque from the separate air motor for rotation is transmitted by the same shank adapter.

If drilling is to be continued after reaching bedrock both the ring bit and the cross bit are collared a few inches into the rock for secure support of the drill pipe. The series of pipes are then disengaged from further drilling by disconnecting the top drill pipe from the shank adapter. An extra rod is added and drilling continued with the extension steels alone.

When the hole has been drilled to a predetermined depth in the bedrock the extension steels are withdrawn leaving the drill pipe as a lining in the overburden section of the hole and thus forming an open connection between the hole in the bedrock and the surface.

During drilling through overburden, soil sampling and testing of the soil may be carried out whenever desired. The drill pipes and the ring bit are withdrawn after the completion of such operations as the insertion of plastic tubes for charging or the entry of grouting equipment, etc.

The Equipment

Rock drills used for the OD Method are of two types, the Atlas Copco BBE-41, and the heavy-duty BBE-51 (Fig. 2). The stroke of the piston is fully utilised and independently controlled to give the required percussive action on the special shank adapter. The piston type air motor—also independently controlled—transmits a very strong torque via a reduction gear to the drill chuck and shank adapter.

Motor and gearing are built into a housing mounted on the front head of the machine. Water flushing is effected through the central flushing tube of rock drill. The rock drill is attached to a cradle which runs along a chain feed driven

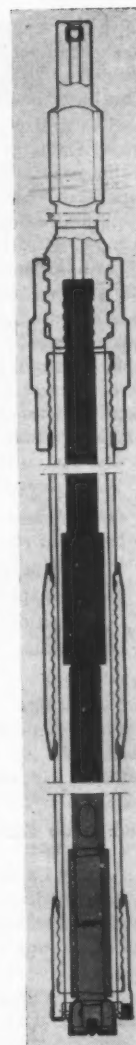


Fig. 1, above, shows a section of the Sandvik Coromant drilling equipment

Fig. 2, alongside, shows the working principle of the rock drill

by a four-cylinder air motor. The assembly may be mounted on special vertical rigs as at the Lindö Canal project, or on a rubber-tired carriage or on tracks. Mounting arrangements can be made to suit prevailing site conditions.

The drill pipes are made of cold-rolled tubes of alloyed steel. The large $\frac{1}{2}$ in. (12.5 mm.) diameter flushing hole of the $1\frac{1}{2}$ in. extension rods is an important feature as it gives an optimum flow of water under high pressure. The top drill pipe and extension rod are connected to a special shank adapter—the drill pipe being screwed to the inside rope thread of an adapter sleeve which in turn is screwed on to the external trapezoidal thread of the shank adapter.

When disconnecting pipes and rods from the adapter, the adapter sleeve with trapezoidal thread will be unscrewed first, leaving the rope-threaded rod end in the adapter to be disconnected. In particularly difficult ground and at great depths a special head for separate flushing is used to ensure that a maximum quantity of water reaches the bits to remove grains and cuttings.

The Overburden Drilling Method can be used for:

- Drilling and blasting of bedrock without previous overburden removal;
- Mineral prospecting;
- Subsoil exploration;
- Investigations for rock location;
- Underwater drilling;
- Grouting;
- Anchoring.

The method may also be used for sinking wells of reasonable depth for groundwater investigations, measuring soil permeability and testing strata strength.

The Lindö Canal

At the Lindö Canal project, located near the City of Norrköping on the Baltic coast of Sweden, surveys showed that the instability of the waterlogged clay would have made dry excavation very expensive.

After considering several alternatives it was finally decided to drill into the bedrock and blast without first removing the overburden. The soil and fragmented rock could then be excavated together by dredging. The length of the Lindö Canal is about 4 miles (6 km.), width 180-195 ft. (55-60 m.) and the depth about 33 ft. (10 m.). For this a total of 4,715,000 cu. yd. of overburden and 226,300 cu. yd. of solid rock were excavated.

The rock drills were mounted on special rigs with 53 ft. (16 m.) long chain feeds. Each drill rig was mounted directly onto a pre-fabricated bedplate which could be moved parallel with and sideways to the canal route by means of I-beam frames and tracks of steel sheet piling. The track system allowed the full width of the canal to be drilled progressively. Certain sections were drilled from the ice during the winter months.

It is remarkable to note that no secondary blasting was necessary. During the whole excavation only a couple of boulders required raising as they were too large for the dredger buckets. Boulders larger than approximately 32 in. (80 cm.) were prevented from being carried up the full run to the dredger tower in order to avoid the risk of damage when dumping on the barges. Fragmentation was good as an average of only 10 such boulders were crane-handled for each barge filled. Each barge carried approximately 260 cu. yds. (200 m³).

The total saving by drilling and blasting overburden and rock simultaneously was quite considerable. In addition, the work could be carried out comparatively quickly without heavy investments in equipment and with a small labour force.

More Blue A.

PLANS have been announced for a 90 per cent increase in the production of blue asbestos fibre at Wittenoom Gorge, in the north-west of the State of Western Australia. Such an increase in output, from the present 260 tons a week to 500 tons a week, will help satisfy the increasing home market requirements as well as export demands. The plan is already being implemented and it is expected that output will be raised to the planned figure by Christmas.

Because of the quality of equipment already installed by the operating company, Australian Blue Asbestos Pty. Ltd., practically no further capital expenditure will be necessary. Capital investment in the Wittenoom Gorge mine is already around £3,000,000*. An increase in underground labour of about 25 per cent will be the main means of achieving the higher output. There are at present about 400 employees at Wittenoom Gorge. The target of 500 tons of blue asbestos a week will lift the gross value of production at Wittenoom from £25,000 a week to £50,000 a week, bringing the company's turnover to £2,500,000 a year.

Australian Blue Asbestos Pty. Ltd., a subsidiary of one of Australia's biggest companies, Colonial Sugar Refining Co. Ltd. (known as C.S.R.), started large-scale operations at Wittenoom Gorge in 1943. The Colonial Sugar Refining Co.'s interest in blue asbestos stemmed from its production of "Cane-ite" and hardboard for the Australian building

* All currency values are in £ Australian unless otherwise stated (£125 Australian = £100 Sterling)

The Wittenoom mill. The mill, designed locally, uses the force of gravity to move materials forward through the factory



Asbestos from Australia

industry. During World War II C.S.R. became interested in the manufacture of fire-proof board, which required asbestos. At that time Australia was importing all her requirements of asbestos from Canada and South Africa, but, with the steady progress at Wittenoom the cost of Australian asbestos fibre has now been halved. Operations were mechanised to the greatest possible extent so that by 1953 mining costs were 38.2s. a s.ton of asbestos-bearing rock, which compared favourably with the costs of other mining activities already operating in Australia and which has continued at a similar comparative level.

Wittenoom Gorge is 700 air miles from Perth and 200 road miles inland south from Roebourne on the north coast of Western Australia. It is an arid and isolated area, but it is estimated that at least 3,000,000 tons of blue asbestos lie under Wittenoom Gorge waiting to be recovered. The blue asbestos is shipped overseas or to the eastern States of Australia for processing, from the port of Samson, a few miles north of Roebourne.

The crocidolite seams occur in near-horizontal beds of ferruginous quartzite, a deep blue in colour and very hard. The principal exposures are in three neighbouring gorges—Dale's, Yampire and Wittenoom. These gorges are several hundred feet deep and seldom more than a quarter of a mile wide at the bottom. In the rainy season creeks flow near their bases and sometimes floods interfere with operations. Earliest recorded production from the region was in 1937. Large-scale operations were not started until 1943 when the

areas were leased out to the present operating company.

The fibre is classified in three grades. About 40 per cent is the top grade, that is, exceeding $1\frac{1}{2}$ in. in length. Six per cent is in the second grade between $\frac{3}{4}$ in. to $1\frac{1}{2}$ in. in length. The remainder is less than $\frac{3}{4}$ in. in length. After classification the fibre is packed into jute sacks, each containing 87 lb. of fibre. The long and medium fibres are used for spinning. They go into the production of brake linings, gaskets and fire-proof cloths. The short grades make building boards, piping, roof sheeting and other asbestos cement items. Wittenoom's blue variety is especially valuable in that it is acid resistant and therefore an important item in processes where acids need testing.

Present major markets, apart from Australia, include the United States, the United Kingdom, Japan and several European countries including Italy. A few years ago, Australian Blue Asbestos Pty. Ltd. secured a reasonably firm overseas market through the Johns-Manville Corporation of New York, one of the world's largest consumers of asbestos, and through various large European companies in the asbestos cement business.

In 1959-60 Australia exported 12,633 s.tons of blue asbestos fibre valued at £1,171,026. This went to Malaya (10,053 cents), New Zealand (1,030 cents), Singapore (6,014 cents), other Commonwealth countries (321 cents), Belgium-Luxemburg (6,328 cents), Italy (43,657 cents), Japan (37,748 cents), United States (145,878 cents), other foreign countries (1,639 cents). In 1958-59 the export figure was 8,180 s.tons.

This latest development is breathing new life into the industry, which is rapidly becoming another of Australia's important national assets.

General view of Wittenoom Gorge. The terraces where mining takes place are clearly visible



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WET CONDENSERS FOR HANDLING FUME AND FURNACE GASES

WHILE the modern tendency in the handling of fume and gases from smeltery and wet metallurgical extraction works appears to be largely towards electrostatic precipitation, the value of the wet condenser is not to be underestimated. Many, if not most, of the large American undertakings appear to favour the "electric-filter" for various reasons, as the dust recovered may be dealt with daily if so desired, and obviates any need for drying treatment. With the wet condenser there is little option but to allow the wet sludges to accumulate for some time before removing, and following settling and filtering, drying then becomes necessary, at least as a general rule. The prevalence of quantities of sulphur oxides, not to mention chlorine, however, has been responsible for perseverance with the wet recovery system and many wet condensers are used at the present day.

The latter units are of more account where some direct use may be made of the acid obtained, but where this total is small, the same interest is not evident, and the gases with their metal values sometimes go to waste. A brief review over the past generation indicates that, even where much sulphur was present, few attempts at recovery were considered, at least for many years. One large copper undertaking in Spain used these converters but without any provisions for handling the gases evolved, which were allowed to pass directly to the air. As the blast matte usually contained at minimum 20 per cent sulphur, about one-fifth of the converter charge in being concentrated to blister copper was thus lost, and much of it descended upon the surrounding waste land.

A zinc smelter located at the seaside for many years roasted its blende in multi-deck roasters, under the impression that the prevailing winds, which normally removed the gases seawards, would obviate the need for condensing arrangements, but local complaints ultimately resulted in a small sulphuric acid plant being installed (some of the blendes contained 28 per cent sulphur, but the work here largely accommodated the calcining of calamines, which accounted for the initial unwillingness to embark on sulphuric acid production).

A nickel smelter near an industrial area belonged to a different category, since the garnierites were sulphur-free and required this constituent to be added through the agency of barytes or calcium sulphide waste, and in so far as blast furnace and converters were concerned, necessitated the use of scrubbers, more for the purpose of eliminating arsenic, than from any intention of making acid. The acidulated liquors were run to a nearby canal. Although the refined nickel matte could contain some 35 per cent sulphur, the slow nature of the roasting in a capacious bell-shaped hearth, meant that the discharge SO_2 content was never very high, and was easily accommodated by the scrubber.

Even after the First World War a firm engaged on treating aluminiferous pyrites persisted in the initial roasting in open

trenches, where the sulphurous gases bleached all grass in the nearby surroundings. Later, with a view to separating alumina from the iron salts present, roasting was done in a form of reverberatory furnace, the gases being recovered in a condenser, and ultimately consumed in making sodium thio-sulphate solution. In the chloridizing roasting of burnt pyrites and poor copper ores, all gases were condensed to form a mixture of dilute sulphuric and hydrochloric acids, later used for extraction purposes.

Ramifications of the Wet Condenser

Thus the condenser is regarded in some quarters as an integral unit in the plant layout, whereas in not a few of the large metallurgical undertakings in the U.S.A. relatively little regard is paid to such gases, other than to recover all metal values.

Otherwise American systems of handling the gases are the last word in precision. Even small refining concerns are equipped with a preliminary cooling arrangement of inverted U-tubes, followed by electro-static precipitators, while in certain of the large works a double electric-filter is used. The matter of using lavish proportions of water means that exceedingly minute quantities of some of the rarer constituents are lost in the sense that it would not be economical to handle such dilute liquors. Where acid liquors can be utilized, scope is thus offered for treatment which is denied in various ways when condensation is only for the purpose of depositing oxides or metallic particles. A survey of a number of small extraction and refining works revealed that there were many adaptations of what might be described as the Gay-Lussac tower.

Either one of these, or three in a row, fed by a common overhead water tank, could accommodate all gases and eject a virtually acid-free gas to the stack. The latter was usually 60 feet in height, and so packed with coke as not to impede the draught, with furnace gases entering at the bottom. An electrically driven fan, with stainless steel impellers, assists the passage of the gases up the tower, while a centrifugal pump maintains the water level in the overhead tank constant. One of the latest adaptations of these condensing towers is equipped with automatic water level, gas-measuring, temperature recording, and acidity and SO_2 content recording apparatus—on a single panel, whereby all operate automatically, providing a liquor of constant acidity despite changes which may be made in the roasting process.

Formerly it was necessary to make periodical individual tests of the gases emitted to the chimney, where the maximum sulphur oxides had to be 3.5 grains per cu. ft. and hydrochloric acid 0.20 grains per cu. ft. The acid liquors ultimately recovered contained from 0.08 to 0.12 grain silver per 100 gallons, while the copper content, although variable, usually averaged about 7 grains per gallon.

The condensing towers are purposely constructed very high (in order that saturated absorbing liquid and exhaustion of the gases may proceed unhampered) and are made of select acid-resisting sandstone slabs, held in place by T-pieces. A float in the overhead tank controls the water supply from the centrifugal pump, the water being splashed over a lead-capped refractory plate and distributed evenly to the gas, which at the top is virtually denuded of metal values or acid contents. The same coke is retained in the condensing tower for as lengthy periods as possible, provided it does not break and cause clogging of the passages. The reason is that from experience it was realised that small as was the gold content, it tended to accumulate in this coke.

By

C. C. Downie

At the bottom of this tower is located a set of settling tanks, fed from a common chute, into which a fine stream of dilute sodium sulphide is run. Formerly, small pieces of ferrous sulphide made by fusing iron pyrites with scrap iron were used, and in the acid solution they gave off a constant stream of hydrogen sulphide gas. Careful use of sodium sulphide was found to be more convenient, since the acid was always predominant, which meant that precipitation of the metal values was always more or less complete. When gold contents were relatively high, this had to be given most attention, but they normally averaged 0.30 grains gold per 100 gallons, and 2 to 3 grains per 100 gallons of silver, these values being reduced by this treatment to the figures previously given, no gold ultimately remaining in the liquor. Thus on the basis of 40,000 gallons, and despite the coke in the tower removing a certain indiscriminate amount of these metals, the process here proved economical. The same remarks apply to the selenium and tellurium contents, and the sodium sulphide in the acid solution accounted for these *in toto*.

Gold, selenium, and tellurium are generally described as being precipitated in the arsenic group, but the acidification of the sodium sulphide means that they are actually being precipitated by hydrogen sulphide. After passing through the settling tanks, and being filtered, the liquors go to the extraction department, while the dark brown mud is sold off for its gold and silver contents, after being dried and then slightly dampened to forestall dusting troubles. In view of the wide demand for selenium and tellurium, it is remarkable to relate that not a little of these were thrown out as waste—even in some cases to the present day.

Thallium and Other Rare Metals

It entirely depends upon the source from which the original ores are obtained whether or not thallium is present, and from analysis more of this constituent was found in the flue dusts than in the recovered condenser sludge. This is not surprising since, although sodium sulphide by itself will precipitate thallium, this sulphide is soluble in acid solutions and hence, in the foregoing process, what actually reaches the acid liquors is likely to be lost at least temporarily in the acid solution. Where this liquor is ultimately subjected to one or other of the iodide systems for silver recovery, thallium will then be precipitated. In the presence of sulphur, chlorine and other agents, thallium may be present in the roasting hearth as sulphate, chloride, or oxide, but none of these should be volatile at the temperature of 300 deg. C. or less obtaining at the termination of roasting (conditions are not such that thallic chloride which decomposes at around 100 deg. C. is formed). Analysis showed that this metal appeared in the flue dusts and where the process otherwise justified acid treatment, thallium was ultimately found in the silver.

Insofar as ordinary iodide treatment is concerned, none of the base metals exert any influence; silver, together with any gold, is precipitated virtually in pure condition, except for mechanically incorporated lead, iron and copper salts. The process thus differs when thallium is present, since it is completely precipitated by zinc iodide, iron iodide, or sodium iodide. Another feature is that in following the subsequent sections of the process, namely, the reclamation of the iodide liquors by boiling with sodium sulphide, thallium sulphide is obtained together with the silver sulphide.

When ultimately dispatched for silver refining, this thallium is usually thrown out as waste but, of course, it is not a particularly valuable commodity like selenium. It has apparently been proposed as a material for insoluble anodes, in combination with lead and tin, such alloys, containing 10 per cent thallium, being resistant to a wide range of acid solutions.

The foregoing process affords a means of getting round the complications of other methods described elsewhere, which, without the justification of using iodide liquors for silver recovery, could not be economically applied. In like manner, normal blast furnace and converter practice yields much of the selenium and tellurium in the blister copper, which, following electro-refining, is acquired in the anode slimes to a considerable extent. Alternatively, where copper is extracted using one or other of the chloridizing systems, most of the selenium appears in the condenser tower acid.

Hence variations in procedures adopted for the regular common metals can make appreciable differences when it comes to recovering rarer elements. Acid liquors from the scrubbers of the nickel smeltery showed little evidence of any rare constituents, although there have been occasions when imperfect working of the converters in the associated cobalt refinery showed traces of cobalt in these liquors, but in too small quantities to justify attempts at reclamation.

In one zinc smeltery where gases from the roasted blends were ultimately used for sulphuric acid production, and particularly with poorer materials containing lead, cadmium, arsenic, etc., spectrographic examination revealed the presence of a number of rarer metals in the acid solution namely, gallium, indium, germanium, and caesium. It was this initial investigation which led to the much more elaborate work of ascertaining at which sections of the flue dust these metals tended to accumulate. Without the condensing of the gases in water, tested over lengthy periods, their initial presence might have been difficult to detect, since samples of dusts taken indiscriminately do not afford the same criterion. Each of these metals are today well known for their industrial applications, which need not be entered into except to remark that indium, which was formerly considered one of the rarest metals, is expected to fall well below the price of silver, in view of the relatively large quantities which are nowadays recovered, this metal being the basis of numerous low-melting point solders.

Recent U.S. Coal Research

CHANGES in explosibility of a mixture of coal dust and air due to the presence of varying amounts of a combustible gas are described in a Bureau of Mines technical publication. During experiments at the Bureau's Health and Safety Research and Testing Centre, the methane gas that is common in many coal mines was exploded with bituminous dust. Two sizes of laboratory-type test chambers were used to simulate mine atmospheres. Some of the conclusions, however, the Bureau said, are applicable to any combustible gas present in a potentially explosive dusty atmosphere. Effects of changes in pressure and convection currents within the test chamber also are discussed in the report and should interest industries other than coal.

Test results, tabulated and discussed in the report, show that adding small amounts of methane to atmospheres with up to four-tenths of an ounce of dust per cu. ft. raised the pressure of a resulting explosion. In concentrations of more than half an ounce of dust per cu. ft., on the other hand, the adding of methane reduced the pressure.

Other research concerns the comparative costs of roof bolting and conventional timbering under similar bituminous coal-mining conditions, analysed by the Bureau in a further report released.

Roof-bolting has supplanted conventional timbering in most of the larger and more productive coal mines of the U.S. in the past ten years. In fact, it has replaced timbering in 13 of the 14 mines studied in the report.

MINING MISCELLANY

The Canadian House of Commons has given a first reading to legislation for the construction of a 438-mile railway line to tap the huge lead and zinc deposit at Pine Point on the Great Slave Lake. Construction is expected to be completed by the end of 1966. The government will pay to Canadian National Railways a subsidy not exceeding \$86,250,000 to acquire land and build the line. Other parties to the agreement are Consolidated Mining and Smelting, in which the Canadian Pacific Railway Co. has a controlling interest, and Pine Point Mines, which in turn is controlled by C.O.M.I.N.C.O. Payments not exceeding \$20,000,000 are to be made to the government on behalf of Pine Point Mines towards the cost of the line, such payments to be based on the annual value per ton of ore and concentrates shipped.

An agreement has been signed with a Japanese nickel mission under which Japanese interests will survey, exploit and process nickel deposits at Pomalaa, S.E. Sulawesi. Other contracts will cover transport and sales. Another Japanese mission is to survey Indonesia's laterite deposits, which are estimated at 1,550,000,000 tons. The Japanese firm Kinoshita Sansho plans to set up a sintering plant. This would enable sintered material to be transported to Japan, states the report, thus making possible the economic extraction of nickel and chromium from laterite.

According to an official of Australian Iron and Steel Ltd., a subsidiary of Broken Hill Proprietary, the long-term plans of the steel industry could make an area about forty miles south of Sydney one of the major coal-producing centres. Depending on the industry's progress, there is a possibility that nine new mines might be opened in the area in the next ten years, at a cost of millions of pounds, to supply coking coal to steel plants in New South Wales and possibly in other States.

It has been announced that Bulldozing and Prospecting Co. (Pty.) Ltd. intends to construct a copper leaching plant near Rehoboth, South-West Africa. The plant will be capable of treating between 4,000-6,000 tons of low grade copper ore at each charging. The announcement states that the high cost of mining, rail-age and shipment has led to the closing of a large number of small mines in the Rehoboth district. The project envisages the production of a 70 per cent concentrate for shipment and it is believed that this may result in the re-opening of a number of mines.

Noranda Mines Ltd. plans to set up a research centre in the Montreal area to study the wide range of materials handled by the company and its manufacturing subsidiaries. The latter include Canada Wire and Cable Co., Noranda Copper and Brass Ltd., and Canadian Copper Refiners Ltd. An initial expenditure of more than \$1,000,000 is contemplated. Projects envisaged include research on by-products of refining copper, a study of the quality and physical properties of copper and its alloys; research in the field of semi-conductors and in chemical fields of interest to the group.

During 1962 the U.S. Bureau of Mines is to seek better methods for utilizing taconite-jaspilite-type iron formations of the Lake Superior district. Such resources represent the largest iron resource in the United States. Sampling and classification of deposits will take place and mining and beneficiation research conducted. Similar work, on a somewhat smaller scale, will be carried out at deposits in several Western and Southeastern States. Bureau investigation of mineral dressing of iron ores, conducted mainly in Research Centres at Minneapolis, and Tuscaloosa, will involve procedures applicable to iron deposits throughout the country. The research will emphasize flotation procedures, conversion of non-magnetic iron minerals to the magnetic form, treatment of slimes, removal of detrimental impurities, and agglomeration of fine-grained concentrate. A promising project involves the partial reduction of iron oxides to metal during the preparation of pellets from taconite concentrate.

An exclusive prospecting order "for all precious metals and antimony" has been granted to the Johannesburg Consolidated Investment Co. Ltd. by the Southern Rhodesia government. According to the *Chamber of Mines Journal*, J.C.I. is interested mainly in antimony, which is thought to be available in working quantities in the Lower Gwelo district in an area of 24½ sq. m., covered by the order.

South African ore deposits were surveyed recently by a visiting team of Japanese technicians, who examined deposits of manganese and iron ore in the Postmasburg area (Cape Province), iron ore in the Tnabazimbi district (Transvaal) and chrome deposits in the Lydenburg and Rustenburg districts. While confirming that reserves of these ores were sufficient to meet Japan's increasing demand, the team pointed out that South African port facilities would have to be improved to accommodate ships of 45,000 tons and over, and that inland transport should also be improved in order to move greater quantities. The group will also study ore deposits in the Rhodesias and Nyasaland.

Deliveries of uranium from the mine at Mouana near Franceville, in the Gabon Republic, have begun and the first shipment has been dispatched to Pointe Noire. All supplies are earmarked for the French Atomic Energy Commission.

A dragline claimed to be the largest in the world is being built at Irkutsk for the gold mining industry, states a report from the U.S.S.R.. Equipped with 170 buckets each of 600 litres capacity, it is 230 m. long and will excavate gold-bearing sand to a depth of 50 m.

A U.S. company is conducting iron ore surveys in the Nicoya peninsula of Costa Rica. It has already carried out aerial magnetic surveys and engineers from the Krupp organization have been called in to assess the possibilities. These activities are still in the exploratory stage.

A new company, Empresa de Esmeraldas, has been set up in Colombia to take over the existing emerald mines from the Banco de la Republica. It is further reported that new and rich deposits of emeralds found by private individuals in the west of the Department of Boyaca have led to a rush by smallholders in search of quick fortunes.

The first lead to be exported from Newcastle, N.S.W., for about 40 years was recently dispatched to Antwerp. It consists of dross bullion produced from Broken Hill ore at the new smelting plant completed earlier this year for the Sulphide Corporation. The consignment of 900 tons is the first part of an order for 1,750 tons placed by Société Générale Métallurgique, which will refine it for resale.

The first consignment of iron ore to be exported from the Sudan was shipped to Yugoslavia early in the current year. Some other deposits of iron ore, as well as occurrences of manganese, have been reported in the Sudan, but in most cases inaccessibility may be an obstacle to commercial exploitation.

As reported last week, the fighting in Katanga led to the suspension of operations for a short period at some of Union Minière's plants. All plants are now back in full production.

Company News

The AEI/Davy-United Steelworks Automation Unit, formed in July 1960 to apply automation to the processing of steel and non-ferrous metals, will henceforth trade in its own right. The interests of Associated Electrical Industries Ltd. and Davy-Ashmore Ltd. in this field are now combined in a jointly owned company, Davy-AEI Automation Ltd. The chairman of the new company is Mr. M. A. Fiennes, managing director of Davy-Ashmore Ltd., and the vice-chairman Mr. C. R. Wheeler, vice-chairman of AEI. The headquarters of the company will be located at Booths Hall, Knutsford, Cheshire.

On Thursday, September 21 some 40 members of the London and Home Counties branch of The Institute of Quarrying visited the Fraser & Chalmers Engineering Works of The General Electric Co. Ltd. at Erith, Kent. Included in the party were Mr. B. H. Marriage, president of The Institute of Quarrying, and Sir Gilbert Davis chairman of the London and Home Counties branch.

Extensive damage to structural timber can be prevented if the outbreaks of rot and woodworm are treated in the early stages. A new company in this field is Property Preservation of 90b High Street, Reigate, Surrey (RE9 6366). The firm maintains a free inspection service backed by mobile teams of timber treatment specialists.

The Department of Scientific and Industrial Headquarters House are now at State House, High Holborn, London, W.C.1. Telephone: CHAncery 1262.

Machinery and Equipment

Europe's Largest Dragline

A walking dragline, one of the biggest in the world as well as the biggest in Europe, is to be used by the N.C.B. in the opencast coal workings at Maesgwyn Cap, Glyn Neath, South Wales. The machine is a Rapier W1800, by Ransomes and Rapier, Ltd. It cost just over £900,000.

The operation of this giant machine, which weighs 1,800 tons, is in the hands of George Wimpey and Co. Ltd. on a contract which involves the stripping of overburden to a depth of 300 ft. to expose and recover anthracite coal. With a bucket weighing 33 tons and having a maximum load capacity of 40 cu. yd. or some 60 tons, the equipment will be able to take huge bites at the overburden.

The boom, of lattice and girder work construction in high tensile steel, is the biggest ever made in this country. It was manufactured at the Thorncliffe Works of Newton Chambers and Co. and its basic length is 208 ft. There are in addition two extensions which permit two operating lengths, 282 ft. with a 30 cu. yd. bucket and 247 ft. with a 40 cu. yd. bucket.

The radius of discharge (vertical) with the longer boom is 260 ft. and with the other 230 ft. Maximum allowable working load at maximum radius is 65 tons with the longer boom or 91 tons with the shorter boom. Dump heights are 130 ft. and 100 ft. respectively.

Being of the cantilever type, the boom is suspended in its operating position by means of a structural steel suspension member connecting the apex of the boom to the gantry head. Derrick ropes and derricking gear are provided only for raising and lowering the boom and do not carry any load during the normal operation of the machine.

While digging, the Rapier W1800 sits on its circular base of 2,380 sq. ft. area and when it is required to move as work proceeds, or from one part of the site to another, it does so through the operation of a walking mechanism for which Ransomes and Rapier hold the patents. On each side of the excavator there is a great rectangular walking shoe attached to a leg structure. The walking operation is carried out by placing the shoes on the ground and lifting the entire machine forward so that by means of the eccentric on which each leg is mounted it moves across the ground, taking 7 ft. 7 in. walking strides.

Other facts about the Rapier W1800 are that it has eight 300 h.p. motors, four of them for hoist and four for drag; also four 225 h.p. walk motors and four more 225 h.p. swing motors.

The machinery house is fitted with a crane gantry on which runs an electric overhead crane with two 10-ton crabs. These are for maintenance purposes and can handle all machinery. The entire machine is designed with a view to ease of handling and speed of operation, being entirely electrically driven with Ward-Leonard Amplidyne control.

In sole control of the movements of the W1800 while digging and walking is one driver, operating from either of two glass-fronted control cabins, one in each side of the superstructure.

The Esco Triple Tapered H.D.S. dragline bucket of 40 cu. yd. capacity was made by Hadfields Ltd. at their East Hecla Works. This is believed to be the

largest dragline bucket in the world, weighing, with rigging, approximately 75,000 lb. The base structure of the Rapier W1800 is 55 ft. in diameter and is built up of rolled steel plates and sections which give the necessary strength and rigidity for digging and walking duties.

The rotate frame is made up of rolled steel plates and flats welded to form four full-length longitudinal girders 14 ft. deep into which are built the circular girders for carrying the roller path which is made of special nickel chrome molybdenum cast steel segments of bridge type rail section. The roller circle consists of a 48 ft. diameter live ring made up of 125 alloy steel taper rollers mounted in a structural frame. A welding set operating on 440 volts 3-phase supply and capable of 200 amps. continuous and 300 amps. intermittent hand welding service is provided for maintenance and for emergency repairs.

It can be said that this Rapier W1800 has been developed from the original Rapier W1400 supplied by them to Stewarts and Lloyds, Ltd., in 1951 when it was described as the biggest walking dragline in the world. That first Rapier W1400 has now been in continuous round-the-clock operation at Corby, stripping overburden from ironstone, for 10 years and a second W1400 was set to work at Corby in 1960.

At the present time a Rapier W1800 is being made for Stewarts and Lloyds at the Waterside Works of Ransomes and Rapier. Still another Rapier W1800

is nearing the final stages of erection at Roxby, near Scunthorpe, for the United Steel Companies, Ltd., who have had a Rapier W1400 working in their opencast ironstone mine at Exton Park, Rutland, since 1957.

GRINDING WITH ORE OR ROCK FRAGMENTS

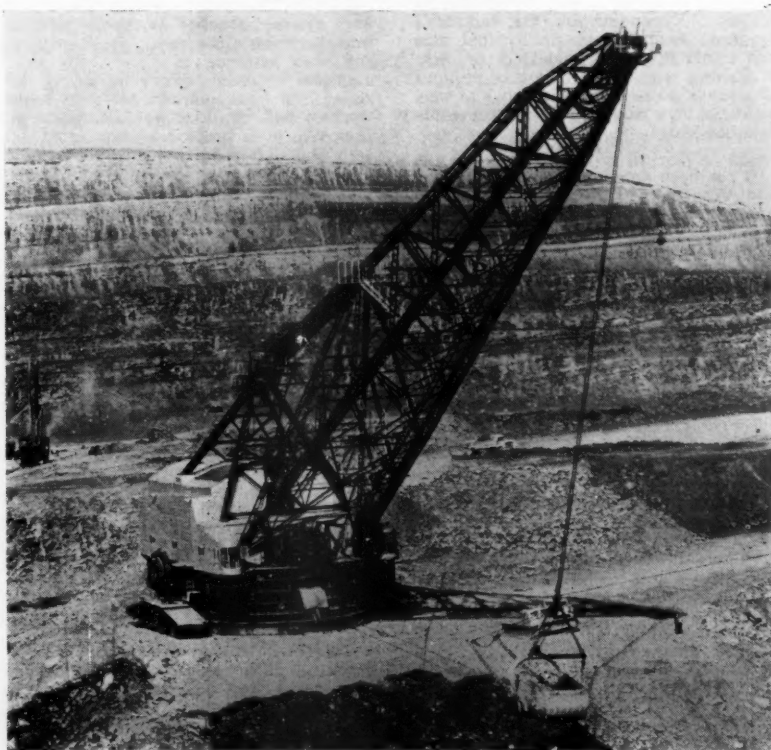
An article in *Teknisk Tidskrift* (Stockholm) describes the Hardinge cascade mills and the Boliden control system when grinding takes place with ore or rock fragments used wholly or partially as the grinding media.

By showing the relationship between the feed rate, mill dimensions and the work done at the Boliden Mining Co. in comminution according to Bond, it is clear that with a given feed rate, the charge volume and the mill powder are increased at finer grinding. Within certain size ranges, an increase in the feed size causes a reduction in the work index until an optimum largest particle size in the feed is reached, and a decrease in the feed size will bring about a reduction in grinding capacity.

Similarly in a suitably graded charge of ore fragments there is an optimum ratio between the feed and product size and the grinding body size.

For a close control of the final product from a variable feed composition as well as to maintain a constant feed rate, Boliden has developed a control system which ensures that at any time the feed is given an optimum size range, by means of adjusting the shell speed and by a preliminary crushing to an extent determined by the desired size of the ground product. That is to say, for fine grinding, sufficient number of grinding bodies

The biggest walking dragline in Europe, the Rapier W1800, showing the Esco triple tapered H.D.S. dragline bucket of 40 cu. yd. capacity which weighs, with rigging, approximately 75,000 lb.





In this illustration of a substation in Cynheidre Colliery in South Wales, the steel channel system termed Unistrut is employed to suspend electrical cables feeding No. 1 shaft, from inserts in the underside of the concrete roof slab. This arrangement permits a multiplicity of supports to be attached, providing for any variety of shape or size of cable or pipe to be catered for. The flexibility of Unistrut makes it simple to alter any layout at a moment's notice. Unistrut is manufactured by the Unistrut Division of Sankey-Sheldon Ltd. one of the Guest, Keen and Nettlefold group

must be present. In order to control the size distribution the feed is sized and crushed as required and the various fractions stored in bins. This is done at Vassbo mine, removing the required amount of oversize for crushing and then splitting the feed into three size ranges < 40 mm., 40 to 80 mm. and 780 mm., so that the feed size range can be regulated and at the same time, the speed of the mill can be varied by a Ward-Leonard system.

With a given charge or size range, the mill will have a high efficiency for coarse grinding at a high speed but a low efficiency for fine grinding and by reducing speed the fine grinding efficiency can be increased whilst the coarse grinding efficiency is reduced. This is because at higher speeds, the large pieces crush that part of the charge required as media for fine grinding, but at lower speeds (about 50 to 60 per cent of critical) the small pieces tend to accumulate since impact is reduced. Secondary grinding has, of course, been carried out autogenously for many years, particularly on the Rand.

At Boliden conventional rod milling followed by a "rock" mill is used but a part of the crushed feed is screened providing feed for the rod mill from the undersize and media for the secondary mill from the oversize. Another modification is to employ a screen with a progressively increasing size of aperture towards the discharge, so that by controlling a suitable splitter the range of size used for media in the secondary mill is readily adjusted.

It is not essential for an ore to be hard and autogenous grinding can be used for almost any brittle ore with a few exceptions. Elastic ores, however, are not suitable. Either dry or wet grinding is possible but usually costs are lower with wet grinding, whilst ore as the tumbling load tends to more selective comminution.

Technical Briefs

Treating Iron Ore at Wabush Lake, Labrador

In order to examine the problems of concentrating the iron ore from Wabush Lake, a 30 l.t.p.h. pilot plant has been constructed and placed in operation in early 1960. The ore contains medium grained specular hematite, quartz, rather earthy limonite or goethite, martite and fine magnetite plus smaller quantities of other minerals.

Early work showed that liberation was not difficult and that gravity yielded a good concentrate at about minus 28 mesh whilst a high grade concentrate could be prepared by magnetic separation after grinding to 100 mesh. Furthermore flotation can be used to lower the manganese content if desired.

Fears were entertained as to the efficiency of wet screening at 28 mesh but they were unfounded since the critical size material was only a small amount. Consequently wet grinding has been quite successful using an autogenous mill. The undersize from screens is concentrated easily on spirals, the tailing from which tends to carry some values in the finer sizes and can be cleaned by magnetic or gravity means. Similarly magnetite can be removed ahead of spirals. The spirals gave good results down to 150-200 mesh but recovery fell off badly on finer material. Tables can be used to scavenge tailing and make a better recovery than spirals on this duty but cost is higher. On the other hand, separating tailings in a cyclone at about 100 mesh, thickening and treating the overflow on tables seems possible.

Although flotation has not proved acceptable for primary concentration, it can be used to control the manganese content of the gravity concentrate since the specular hematite floats readily from the manganese rich minerals.

CONCENTRATION OF DIAMONDS

The Denver Equipment Co. has recently issued a bulletin (No. M7F74) dealing with diamond recovery both from alluvials and Kimberlite. The use of heavy media both for dealing with coarse material as well as a somewhat finer size range in cyclones is discussed as well as reconcentration using attrition grinding and screening, grease belts and electrostatic separation.

CLEANING FINE COAL

Although the dense medium cyclone has been used fairly extensively in Europe for coal cleaning, it is only recently that it is being adopted in the U.S. The process was first described by Driessen in 1945 and by 1958 there were 18 plants in Europe.

With the increasing interest in improved fine coal treatment in the U.S., the U.S. Bureau of Mines has carried out tests on a number of coals and published the performance data which show that with one exception, a remarkably sharp separation could be made between the coal and impurities. One dense medium cyclone plant is now in operation in the U.S. and others are planned.

*

The results of an investigation made by the Bureau of methods for determining

phosphorus in coal ash and coke ash has been published and a comparison made between standard procedures in other countries and those recommended by the American Society for Testing Materials (A.S.T.M.)

The methods investigated included volumetric, colorimetric and gravimetric ones and all were found to be about equally accurate and may be used alternatively. The gravimetric methods are perhaps the simplest to use, volumetric more rapid when a number of analyses are made and colorimetric very suitable for numerous rapid determinations but, of course, require suitable photometers or spectrophotometers.

A method for estimating the phosphorus directly in coal is given which gave results which checked satisfactorily with determination made by A.S.T.M. method on ash from the same coal. The results show that although the British and the A.S.T.M. volumetric methods differ in detail, they are equally suitable and the colorimetric methods based on the molybdenum blue reaction, using either stannous chloride or hydrazine sulphate as a reducing agent give satisfactory results. The molybdivanadate colorimetric method is especially suitable when used in conjunction with procedures for complete analysis of ash.

PULP DENSITY CONTROL

The gamma ray type of density meter is being used at Kennecott's Ray Mines Division's plant at Hayden, Arizona, U.S. to control the density of the underflow from a 325 ft. traction thickener serving the new water recovery plant.

The underflow is divided into two pipelines using a Y junction so that a constant flow is maintained in one branch on which is situated the density measuring device. When pulp density changes, the detector unit generates an error signal which modulates a diaphragm valve on the other branch of the discharge. In this way, it is possible to control the underflow density between 46 per cent and 57 per cent solid, maintaining a clear overflow on the thickener.

The installation is said to measure and record continuously with an accuracy of 10.5 per cent solids when calibrated against the specific gravity of the underflow being handled.

ESTIMATING PHOSPHORUS PENTOXIDE CONTENT

Report of Investigations 5829 summarizes studies by the U.S. Bureau of Mines in developing a simple method for estimating the phosphorus pentoxide (P_2O_5) content of finely ground sedimentary phosphate ores and beneficiated products. The method used involved leaching, filtration, and precipitation. The Bureau found that measurement of the volume of ammonium phosphomolybdate precipitate obtained from samples containing 16.8 to 37.7 per cent P_2O_5 and the use of an appropriate calibration curve permitted estimates of percentage of P_2O_5 content accurate within ± 1.1 to ± 2.6 per cent, respectively, at the 95-per cent confidence limits.

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MAP OF THE GOLD MINES OF THE KINROSS AREA

Copies of this map, prepared by *The Technical Map Service* of Johannesburg, are now available in London. They show (as at November 1959):-

- the exact position of each mine on the field.
- where on each property boreholes have been sunk, and what has been the core recovery on reef intersection.
- what shafts are being sunk.

Accompanying this map is a small outline map, bringing the borehole results up-to-date as at October 1960.

★While a mine is at the development stage, it is of vital importance to have a visual picture of its position in relation to the field as a whole. Otherwise the quarterly results published by the companies lose much of their significance.

★Results reported from adjacent mines often have a direct bearing on the one in which you are interested, which, however, can only become apparent if you have clearly in mind the position of the properties in relation to one another.

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Metals and Minerals

Price Cuts in the U.S. Aluminium Market

While prospects for a further round of expansion in the U.S. aluminium industry are becoming increasingly favourable, the domestic ingot price of 26 c. per lb., which has remained unchanged since December 1959, has latterly been under growing pressure, due in part to the existence of some 500,000 tons of idle capacity within the country, but also to vigorous competition from Canadian metal and to rising imports from Europe.

The effective devaluation of the Canadian dollar has given Alcan a potential price advantage in the U.S. market which until recently the company has apparently been reluctant to exploit, due, presumably, to fear of retaliatory higher tariffs. Latterly, however, Alcan, which has evidently been under some pressure from its U.S. customers to reduce its price, has been offering metal at the Canadian published quotation of 23½ c. (Canadian) per lb., delivered at the Canadian-U.S. border, plus U.S. duty for handling and other charges. In the New York area this works out at about 24.30 c. per lb.

At the same time, European aluminium has been entering the U.S. at prices ranging from 23 c. to 24 c. per lb., including the import duty. Freight charges to nearby plants would add ½ c. to this amount. According to press reports, some U.S. produced ingots shipped to Europe have been finding their way back to their country of origin, where they have been selling at around 24 c. per lb. at home ports.

In the circumstances it is scarcely surprising the Alcoa should have an-

nounced a reduction of 2 c. per lb. in the price of 99.5 per cent minimum purity ingot, effective September 25 shipments, bringing its price down to 24 c. per lb. The announcement stated that the company was reviewing the prices of its other products, but emphasize that those of most of its fabricated products had already been reduced below 1958 levels as a result of the extremely competitive conditions existing in the industry. (Cuts in the prices of some grades of billet were subsequently announced.) The company also pointed out that during the same period there had been four substantial increases in labour costs, as well as steadily rising material costs. Alcoa's example has been followed by Reynolds and doubtless other U.S. producers of primary metal will fall into line, if they have not already done so.

The implications of this price war are considerable. In the first place, the effect may be to deter some small companies, mainly independent fabricators, who have been planning to enter the producing side of the industry. Then again, the industry has been anxious to get mill prices back to a higher level and there have been some signs lately of a hardening tendency. Now these prices may come under renewed pressure. Of some significance in this connection is the fact that many fabricators do not purchase ingots, but buy semi-processed billets, extrusions, sheets, plates, rods, bars and other products.

The lower ingot price, if maintained, will, of course, give aluminium a further shot in the arm in its battle with other

materials. This could be particularly advantageous if, as seems probable, the steel industry finds itself under pressure from President Kennedy to keep its prices unchanged. Indications are that the price of tinplate is unlikely to be raised in the foreseeable future, and here, too, aluminium's competitive position will be strengthened. (Alcoa is considering a cut in the price of aluminium can stock.) At the same time, the price cut will be of assistance in meeting the challenge from plastics and other materials. The effect on producers' profits will obviously be less favourable.

*

An announcement by Alcoa received as we go to press, states that the company is reducing prices by up to 2 c. per lb. on many of its finished aluminium products, including the bulk of the big volume sheet and plate items. Canned sheet prices, however, are to be maintained.

G.S.A. TO SELL COBALT

The United States G.S.A. is seeking Congressional approval for the disposal of 265,000 lb. of cobalt oxide and 5,500 lb. of cobalt carbonate which are considered to be in excess of stockpile requirements. Cobalt oxide is used in the manufacture of driers for paints; cobalt carbonate is an effective catalyst in hydrocarbon synthesis.

LESS WEST EUROPEAN COPPER FOR SOVIET BLOC

Exports of copper from West Europe to East Europe fell last year from 56,000 tons to 40,000 tons, according to a report published here today by the Economic Commission for Europe, an United Nations organization.

The report said the decline, which largely affected British shipments of copper wire, followed the trend of recent years as the Soviet Union has stepped up imports of raw copper direct from producing countries like Chile and Rhodesia.

East-west European trade in aluminium last year totalled some 10,000 tons in each direction. In 1959 there had been an appreciable East European export surplus. Exports of Russian tin declined in 1960, in line with its undertaking to the I.T.C., says the report.

GORDON LAKE NICKEL SCHEME

Exploitation of the Gordon Lake nickel property of Nickel Mining and Smelting Corp. is expected to reach the production stage in the autumn of 1962. The erection of the mill building and other major construction is likely to start next spring.

Ore reserves have been conservatively put at 825,000 tons graded at 1.75 per cent nickel, 0.72 per cent copper and \$3 in precious metals. It is estimated that these reserves are adequate for more than five years' operations at a planned rate of 700 tons a day. And this does not take into account a new deep ore zone discovered in the property last Spring.

It was decided to start the Gordon Lake scheme after Inco agreed to buy Nickel Mining's nickel-copper concentrates over a five-year period.

The scheme is being financed by Faraday Uranium Mines which is to purchase up to \$3,000,000 of Nickel Mining

LONDON METAL AND ORE PRICES, SEPT. 28, 1961

METAL PRICES

Aluminium, 99.5%, £186 per ton
Antimony—
English (99%) delivered, 10 cwt. and over £230 per ton
Arsenic, £400 per ton
Bismuth (min. 1 ton lots) 16s. lb. nom.
Cadmium 11s. 0d. lb.
Cerium (99%) net, £15 0s. lb. delivered U.K.
Chromium, Cr. 99% 6s. 11d./7s. 4d. lb.
Cobalt, 12s. lb.
Germanium, 99.99%, Ge. kilo lots 2s. 5d. per gram
Gold, 250s. 2½d.
Iridium, £20/£23 oz. nom.
Lanthanum (98%/99%) 15s. per gram

Magnesium, 2s. 2½d./2s. 3d. lb.
Manganese Metal (96%/98%) £275/£285
Nickel, 99.5% (home trade) £660 per ton
Osmium, £17/£22 oz. nom.
Osmiridium, nom.
Palladium, Imported, £8 12s. 6d.
Platinum U.K. and Empire Refined £30 5s.
Imported £27 7s. 6d./£27 17s. 6d.
Quicksilver, £62 ex-warehouse
Rhodium, £43/£45 oz.
Ruthenium, £14/£16 oz. nom.
Selenium, 46s. 6d. per lb.
Silver, 79½d. f. oz. spot and 80½d. f. oz.
Tellurium, 37s. 6d. lb.

ORES AND OXIDES

Antimony Ore (60%) basis 30s. 0d./33s. 0d. per unit c.i.f.
Beryl (min. 10 per cent BeO) 270s./275s. per 1. ton unit BeO
Bismuth 65% 8s. 6d. lb. c.i.f.
.. .. . 18/20% 1s. 3d. lb. c.i.f.
Chrome Ore—
Rhodesian Metallurgical (semifriable 48%) (Ratio 3:1) £15 5s. 0d. per ton c.i.f.
.. .. . Hard Lumpy 45% (Ratio 3:1) £15 10s. 0d. per ton c.i.f.
.. .. . Refractory 40% £11 0s. 0d. per ton c.i.f.
.. .. . Smalls 44% (Ratio 3:1) £13 5s. 0d. per ton c.i.f.
.. .. . £11 15s. 0d. per ton f.o.b.
Pakistan 48% (Ratio 3:1)
Columbite, Nigerian quality, basis 70% combined pentoxides (Ratio 10:1)
Nb₂O₅ : Ta₂O₅ 150s./160s. 0d. per 1. ton c.i.f.
Lithium Ore—
Petalite min. 34% Li₂O 50s. 0d./55s. 0d. per unit f.o.b. Beira
.. .. . Lepidolite min. 34% Li₂O 76s. 0d./80s. 0d. per unit f.o.b. Beira
.. .. . Amblygonite basis 7% Li₂O 75s. 0d./85s. 0d. per ton f.o.b. Beira
Magnesite, ground calcined £28 0s./£30 0s. d/d
Magnesite Raw (ground) £21 0s./£23 0s. d/d
Manganese Ore Indian—
Europe (46%/48%) basis 60s. 0d. freight 73d./75d. c.i.f. nom.
Manganese Ore (43%-45%) 69d./71d. c.i.f. nom.
Manganese Ore (38%-40%) nom.
Molybdenite (85%) basis 10s. 0d. per lb. (f.o.b.)
Titanium Ore—
Rutile Australian 95/97% TiO₂ (prompt delivery) £25/£25 10s. per ton c.i.f.
.. .. . Ilmenite Malaysian 50/52% TiO₂ £11 10s. per ton c.i.f.
.. .. . Ilmenite Travancore 58/60% TiO₂ £15/£15 10s. per ton c.i.f.
Wolfram and Scheelite (65%) 120s. 0d./123s. 0d. per unit c.i.f.
Vanadium—
Fused oxide 95% V₂O₅ 7s. 6d./8s. per lb. V₂O₅ c.i.f.
Zircon Sand (Australian) 65-66% ZrO₂ £16 ton c.i.f.

series "B" bonds and in return will have the option of taking up to 2,000,000 shares of Nickel Mining at 5 c. a share.

U.S. BISMUTH CONSUMPTION FALLS

Consumption of bismuth in the U.S. during the second quarter of this year fell 16 per cent below that during the first quarter, and was the lowest for any quarter since the third quarter of 1958, according to the U.S. Bureau of Mines.

Although the amount of bismuth used in the production of miscellaneous alloys increased by 13 per cent it decreased in all other products. Fusible alloys took 39 per cent of all bismuth consumed, pharmaceuticals 38 per cent, miscellaneous alloys 19 per cent and experimental and other uses 4 per cent. Consumption during the first half of this year totalled 608,000 lb. which was 119,000 lb. less than in the comparable period in 1960.

Stocks, both consumer and dealer, after showing an increase in the first quarter, declined sharply during the second quarter. Imports of refined bismuth in the second quarter were less than half what they were during the preceding quarter. Receipts from Mexico increased and accounted for more than one-third of the total, but imports from

Canada, Peru, and and Yugoslavia were sharply reduced.

Total imports of bismuth during the first half of 1961 totalled 298,000 lb. against 648,000; exports, however, during the first six months of this year were almost double the amount exported during the corresponding period of last year.

U.S. FLUORSPAR

Crude fluorspar produced from U.S. domestic mines totalled 152,988 s.tons in the first quarter of this year. Fluorspar imports for consumption were about 20 per cent lower than in the corresponding quarter of 1960.

Domestic production of metallurgical-grade fluorspar totalled 6,400 tons during the first quarter about 2 per cent lower than in the first quarter of 1960; fluorspar shipped from mines and mills amounted to 7,400 tons showing a 21 per cent decrease from the corresponding period of last year.

Fluorspar consumed in the first quarter of this year decreased by 12 per cent to a total of 155,500 tons less than in the corresponding period of 1960. Hydrofluoric acid plants consumed 18 per cent more fluorspar than in the first quarter of 1960. Steel plants used 44 per cent less fluorspar than in the first quarter of 1960.

houses continue to fall and the total at the end of last week was 5,324 tons which is 192 tons below the previous published level. In addition to this it is believed that a considerable part of the tonnage is in firm hands and this may mean a sudden contraction in the contango rate within the next few weeks.

On Thursday the Eastern price was equivalent to £97½ per ton c.i.f. Europe.

LEAD LOWER—

The lead market is once more receding to the lower point of the present very narrow price range and it seems unlikely that new ground will be broken in either direction before the Geneva meeting in the middle of October. It seems possible that this meeting may see the end of the Lead and Zinc Study Group in its present form, as it seems unlikely that those few producers who have been withholding metal from the market will continue to do so unless the powers of the Study Group are increased to enforce cut-backs on all producers, and at the moment it seems that such a development is very unlikely. The contango rate remains fairly constant and stocks at 10,634 tons show a small decline of 49 tons over the previous week.

—ZINC IMPROVES

The zinc price improved over the weekend due largely to the technical position in London and a slight improvement in sentiment brought about by the end of the General Motors strike, the strength promoted by the technical position being pin-pointed by the elimination of the contango, which took place in spite of a fall of only 68 tons in the weekly stock figure, which is now 6,835 tons. Notice has been posted in the Metal Exchange that a warehouse has now been registered at Avonmouth and it is expected that metal will appear there very quickly, which should have the effect of re-establishing a contango and probably reducing the whole price structure whilst so doing.

OFFICIAL TURNOVERS

Official turnovers (in 1 tons) for the week ending September 22, 1961, with the previous week's figures in parentheses are:—

Copper	...	...	13,975	(11,325)
Tin	...	...	2,305	(1,850)
Lead	...	...	6,850	(10,450)
Zinc	...	...	5,950	(12,400)

Closing prices are as follows:

	September 21		September 28	
	Buyers	Sellers	Buyers	Sellers
COPPER				
Cash	£227½	£228	£225½	£225½
Three months	£231½	£232	£229	£229½
Settlement		£228		£225½
LEAD				
Current ½ month	£64	£64½	£63	£63½
Three months	£65½	£65½	£64½	£65
TIN				
Cash	£938½	£939	£960	£961
Three months	£951	£952	£968	£969
Settlement		£939		£961
ZINC				
Current ½ month	£74½	£74½	£73½	£73½
Three months	£74½	£74½	£73½	£74

Copper · Tin · Lead · Zinc

(From Our London Metal Exchange Correspondent)

All markets had developed weaker undertones by the middle of the week and prices reflected the growing feeling of uncertainty, caused by more pessimistic reports about the industrial activity for the rest of the year in the United Kingdom, Europe and Japan. From America forecasts, although remaining optimistic, are not so emphatic as previously.

LOWER COPPER PRICES

The price structure of copper has moved downwards by a reduction in the price level in London and two corresponding reductions in the U.M.K. price, whilst in America, although the basis remains at 31 c. per lb., the custom smelters intake price for scrap has been further reduced to 25½ c. per lb. The Belgian price, which stood at approximately 29½ c. per lb. on September 19, has been reduced in two stages to the equivalent of 28.80 c. per lb. New York or Antwerp.

It is understood that after a very short period of slow working the copper mines in the Congo are now producing again at full capacity. Elsewhere labour troubles are at a minimum, apart from the strike at Mt. Isa which threatens to be of fairly long duration, but in general the indications are that production will not suffer any set-backs before the end of the year. The continuance of the high Bank Rate in the U.K. and the delivery of fire refined copper to the market, has been a depressing influence both on the price level and on the high rate of contango. At time of writing it seems unlikely that either of these factors will alter for some weeks.

Stocks rose by a further 260 tons at the end of last week, bringing the total to 22,344 tons, the great majority of which is fire refined metal in Liverpool and Manchester.

SHARP RECOVERY IN TIN

By the end of last week it became apparent that there was to be no release of tin from the U.S. stockpile, and the price recovered sharply on speculative buying based on the assumption that the statistical position of the metal would lead to higher prices by the end of the year. Although this view is widely held, there is a considerable body of opinion which believes that with the releases from the Canadian and Italian stockpiles and the sale of the about 4,000 tons of tin from the Texas smelter, the gap between production and consumption will not affect the price until well into next year.

On Tuesday the American authorities sold a further 700 tons of grade "A" tin at a price slightly above \$1.21 per lb., which was very much in line with the Singapore quotation of that day. In addition 100 tons of grade "B" tin were offered but only 20 tons of this were sold, the price for the balance being considered too low. Seventeen tons of grade "C" tin were offered and sold. These results confirm the opinion held by the majority of dealers that the price acceptable to the U.S. authorities for such tenders must be in line with the current Singapore quotation.

In London the market is now marking time pending the meeting of the I.T.C. in London on October 9 and it seems unlikely that there will be any major price movements before then. The great questions are whether the deliberations will produce a new price structure for the Tin Agreement and whether the U.S. will become a member. In view of the various statements which have been issued recently by producer countries, it seems likely that the question of American participation will occupy the major position on the agenda.

Stocks of tin in Metal Exchange ware-

Mining Finance

\$30,000,000 Under Guarantee

At a Press conference in Johannesburg Mr. H. F. Oppenheimer has announced that the Rand Selection Corporation has arranged a loan of \$30,000,000. The loan has been raised privately by the issue of unsecured debentures to certain American institutional investors and of the total amount \$5,000,000 is repayable at the end of seven years and \$25,000,000 at the end of ten years. The overall cost of the funds including interest, fees and all other expenses, is equivalent to an average interest rate of approximately seven per cent per year.

The implications of this announcement stretch far beyond the immediate confines of Rand Selection or of the Anglo American group, for the loan is indicative of a new investment pattern in South Africa. A few weeks ago the South African Reserve Bank announced that a scheme of individual guarantees had been evolved, whereby it was now in a position to consider applications for guaranteeing the necessary exchange for the repayment of new loans which could be considered as being in the interest of the South African economy. This loan to Rand Selection is a particular example of such an individual guarantee and the R6,000,000 S.A. Brewery debenture stock (1974-84), the repayment of which is also guaranteed, is another.

Compared with the issue of equity stock, the guarantee of loans and debentures

which have a specific value and time of maturity is a relatively simple matter and, therefore, it would appear that this method of fund raising will predominate in South Africa so long as overseas investors feel the need for a guarantee of repatriation of funds. However, the raising of funds through loan capital is no new departure in South Africa, particularly in the gold mining section where, in the O.F.S. and the Kinross area, a good deal of the early capital was raised through the medium of loans. Loan capital often postpones the dividend paying stage or at least restricts the early development of the dividend payments, but in the long run it is undoubtedly to the advantage of the shareholders that the equity should not be diluted. Some shareholders might argue that they wished to participate in the loan; whilst this has not been possible in the case of Rand Selection there is no reason why a loan or debenture issue should not be offered to the shareholders and this is the case with the S.A. Breweries issue.

In his statement Mr. Oppenheimer has emphasized that the negotiations for this loan were long and at times complicated. This is significant, for it makes it clear that the American institutional investors were considering the proposals at what could have only been a short time after the blocking of the Rand on June 16. In fact, it is very possible that the

negotiations were initiated before that time. It is interesting to speculate which of the parties did, in fact, initiate the loan arrangements. At first glance it would appear to be Rand Selection, particularly in view of the general long-term shortage of capital in South Africa; at closer examination, however, this may not prove to have been the case.

The rate of interest on the loan is not particularly punitive; in fact Mr. Oppenheimer has described it as satisfactory. Rand Selection have no specific projects at present for which the loan can be used and moreover Mr. Oppenheimer states that Rand Selection "decided to accept the loan". Undoubtedly, in recent times the American institutional investors have been experiencing difficulty in finding suitable investments for their capital and by comparison with many countries suffering from the threat of a Communist take-over South Africa in general and the Rand Selection Corporation in particular, have much to offer. In reply to a question Mr. Oppenheimer said that the loan was well spread amongst a great many American Institutions and it may well be, therefore, that it was in fact initiated in America by two or three large institutions, and that Rand Selection accepted the idea in principle and then decided to offer the loan to a far wider field.

If this was indeed the case then it is a very good sign for the South African economy, for the Americans are not the only people looking for suitable homes for their investment funds.

In providing these guarantees for the release of funds for new investors the South African government must not overlook its responsibilities to those investors who purchased equities before the introduction of the exchange control restrictions. Dr. Diederichs has said that it is hoped to lift the restrictions as soon as possible, but from the point of view of the Republic's economy and overseas buyers of South African goods, it is just as important to remove the import restrictions. If the government is to retain the confidence of both the investing and buying sections of overseas opinion then a nice balance of priorities must be established when the various restrictions are gradually lifted.

PLATINUMS BETTER THAN EXPECTED

The official forecast at the beginning of this year estimated that the net profit of Rustenburg Platinum would be down by some 25 per cent as compared with the previous year. In the event, it has fallen only 17 per cent below the previous high levels. The market conditions have remained quiet throughout the year and the official price of platinum has remained unchanged at £30 5s., but there has been an increase in the level of the sale of by-product metals and this has partly off-set the fall in revenue due to the decrease in total platinum sales.

The net revenue from the sale of metals after adjusting the stock realization reserve and adding sundry income is R6,630,000 compared with R6,785,200 for the previous year. Taxation, as a result of the reduced capital expenditure redemption allowance, has increased from R1,980,000 to R2,631,000. The capital expenditure appropriation is R498,000 and it is expected to rise to R650,000 during the current year. The dividends, totalling 411 cents per share, amount for R3,570,000 in the appropriations.

Now that stocks have been built up to appropriate levels, further reductions

London Market Highlights

The past week was one of disappointment in the mining markets on the London Stock Exchange. South African gold shares, for example, looked on Monday very much as though they were about to embark on one of their periodic upswings. Stimulus for such a move was provided by the weekend remarks of Dr. Diederichs on the possibility of easing South Africa's capital movement clamp-down. But while London put an optimistic interpretation on the speech, there was little impact in Johannesburg and for this reason London's incipient rally petered out. Even so, prices stayed steady enough in rather unexciting trading conditions.

Loraine began to creep ahead, improving to 18s. with the inevitable stirring of hopes of good development news in the coming quarterly. Lydenburg Estates held at the advanced price of 12s., a rise of 1s. 9d. having followed the news at the end of the previous week that Anglo American was making a take-over offer of one "Ofsits" for every five Lydenburg. "Ofsits" which were 7½d. easier at 56s. 10½d. at the time of the news gradually improved to 59s. by Wednesday of this week. The appearance of a jobber's circular aroused some interest in "break-ups" among which Vogels rose 9d. to 4s. 3d. and Robinson Deep hardened to 3s. 9d. Share prices in the platinum group made little response to the better than expected final dividends.

The previous recovery in the copper section which had been largely inspired by news of the Katanga cease-fire came to an abrupt stop following the setback on Wall Street and the wilting metal price. There was no selling of any real consequence, but in the complete absence

of buyers such offerings as there were soon depressed share prices. Nchanga tumbled 2s. 6d. to 43s. 6d. and Rhokana came back 2s. to 43s. Among other Rhodesians, "Lonrho" were particularly firm; the previous week's jump of 10½d. to 8s. which had followed an extraordinary meeting's approval of the proposed new acquisitions in Southern Rhodesia was more than maintained, the shares rising to 8s. 10½d. before profit-taking brought them back to 8s. 4½d.

On Monday, tin shares carried the previous week's recovery a stage further, Ayer Hitam (50s.) and Tronoh (68s.) being particularly firm with rises of 2s. apiece. But enthusiasm began to wane in a subdued market on Tuesday, and Wednesday's fall in the metal price during the morning market on the London Metal Exchange resulted in widespread dullness. Ayer Hitam came back to 48s. and there were many smaller losses. Tronoh, however, held at 68s. and Southern Kinta were also steady at the improved price of 25s. 3d. which had reflected the excellent results and dividend.

The Australian section had its own troubles to contend with. The partners in the Alcoa aluminium project—Western Mining, Broken Hill South and North Broken Hill—which had previously been in particular demand went sharply into reverse when details of the proposed rights issues were announced. Western Mining dropped 2s. to 17s. 3d. and the Broken Hill companies were 10½d. off at 13s. and 6d. easier at 17s. respectively. Meanwhile, Mount Isa's close-down and deadlock in labour talks lowered these shares 1s. to 55s. before a partial rally to 55s. 6d. occurred.

in output will be effected during the early part of the current year in order to stabilize the production at a level in line with market requirements. Conditions in the platinum market remain unchanged and the trading is quiet. In this quiet market it appears that Russian platinum is available at prices lower than the official price. However, there appears to be no change in the general level of demand for Rustenburg's metal. Rustenburg's capital of £868,600 is held as to 43.3 per cent by Potgietersrust Platinum, 39.2 per cent by Waterval (Rustenburg) Platinum, and 17.5 per cent by Union Platinum. These companies usually pay out in full the income that they receive from Rustenburg. The interims and final dividends for these companies, compared with the previous years, are given in the table below.

	1960-61		1959-60	
	Interim	Final	Interim	Final
	cents	cents	cents	cents
Rustenburg ...	121	290	150	347.5
Potgietersrust ...	4.17	10	3.5	8.5
Union ...	6.67	16.25	5.3	13.4
Waterval ...	7.08	17.29	5.8	14.2
Lydenburg ...	4.38	9.38	3.5	8.0

Lydenburg Platinum has no direct holding in Rustenburg but it is indirectly interested through its 26 per cent stake in Waterval.

150 YEARS IN ALL

In addressing the meetings of five Malayan incorporated tin companies of the London Tin group the companies' chairman, Mr. D. R. Mitchell has given the estimated mining lives of the various

properties. This is very important information—by no means always available—and will undoubtedly please shareholders.

Altogether the five mining companies have a total of some 150 operating years before them. The leader is Berjuntai where, of the five dredges, the shortest life is that of the No. 3 dredge at 13 years. The No. 4 dredge has a life of 20 years and the No. 5 dredge, working down the Sungei Sembah, has a life of some 15 years subject to certain lease applications. Working the eastern part of the property the Nos. 1 and 2 dredges have 6 and 8 years life immediately before them. It is then planned that they should move to the new area of 1,005 acres, the acquisition of which was reported last year. A further mining lease has now been granted covering 1,050 acres lying to the west of the other new area. These two areas together are estimated to contain approximately 156,000,000 cubic yards at an average recoverable value of 0.27 lb. per cu. yd. after allowing a recovery factor of 80 per cent on the bore values. In addition, these two leases contain 112,000,000 cu. yd. of lower grade ground and whilst the values may be too poor for this to be an economic proposition at the present, it must be regarded as a valuable asset. Assuming that no other dredges were moved into these areas then the 156,000,000 cubic yards would give the No. 1 and 2 dredges a further life of some 18 years each. The company has also been prospecting in the Batang Berjuntai area outside the mining lease and it is thought that there is some marginal land adjoining the property

which may have a value in the future.

The No. 4 dredge is at present being moved from the Sungei Garing property to Batang Berjuntai and it is anticipated that this project will be completed earlier than originally anticipated. The dredge should now be able to start operations in October this year. As soon as the No. 4 is ready to start the No. 1 dredge will be closed down for about three months. The dredge will then be equipped with new primary jigs and hydrocyclones similar to those installed on the company's other units.

Plans for the mining of the deep area in the eastern part of the property are still under consideration; to work this area a large dredge with a maximum digging depth of 135 feet will be needed. As yet it has not been decided whether to install a new dredge or whether arrangements can be made whereby these reserves can be worked by one of the existing deep-digging dredges already in the group. A new dredge, of the capacity required, would cost something in the order of £1,300,000.

At Lower Perak the directors have decided to sell for scrap the small Semenyih dredge. This is an old dredge with only 4 cu. ft. buckets and, since the general trend in Malaya is to work extensive low-grade areas with large capacity dredges, it would not be possible to find suitable work for the unit. The cost of modernizing the unit would be prohibitive. The remaining lives of the other two dredges, the No. 1 and the No. 2, in the Tanjong Tualang property have been estimated to be about 8½ years and 7 years respectively. The life of the No. 1 unit may be increased by a few years in

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an adjacent area which is at present under application for a mining title.

The large deep-digging dredge at Kuala Kampar, the No. 2, has a remaining life of about 12 years whilst the smaller No. 1 unit has a life of only about one year in its present reserves. However, a mining lease application has been submitted and if approved would grant a further 2½ years' life. The two dredges at Kampong Lanjut have a life of some 11 years each whilst the life of the Kramat property is estimated to be about 9 years.

£A6,600,000 FOR AUSTRALIA'S ALUMINIUM

Western Mining, Broken Hill South and North Broken Hill have announced rights issues designed to raise a total of £A6,600,000 for the financing of the large £A44,000,000 Australian aluminium project, discussed in *The Mining Journal* of June 16 and 23, 1961.

The Western Mining offer is on the basis of 60-for-100 A5s. shares at A12s. 6d. each whilst that of North Broken Hill is 30-for-100 at par of A10s. each. Broken Hill South is first making a free scrip issue of four A1s. shares for each A1s. share held. The A1s. units will then be consolidated into A5s. stock units and the rights offer will be on the basis of one-for-two of the new A5s. units at A7s. 6d. each. All three companies are spreading the payments for the new shares over a period of 2½ years. A portion of the money raised by Western Mining will be for its separate iron ore project in Western Australia.

The equity of Alcoa of Australia will be spread as; Alcoa, 51 per cent; Western Mining, 20 per cent; Broken Hill South, 16.6 per cent; North Broken Hill, 12 per cent; Cushion Trust 0.4 per cent. The balance of the funds required for the aluminium project will come from Alcoa of America through loans.

SWAZILAND IRON ORE

It has been announced from the British Commonwealth Relations Office that the railway providing the link between the iron ore deposits at Ngwenya (Bomvu Ridge) and the Swaziland border is to be constructed. This, together with the extension of the existing line from Goba in Mozambique, will provide the link between the ore deposit and the sea-port of Lourenco Marques. The way is now clear, and the contracts between the Swaziland Iron Ore Development Com-

pany and the Japanese steel companies were signed on September 25, 1961.

The contract provides for the sale of 12,000,000 tons of high grade ore from Ngwenya over a period of approximately ten years and is expected to be worth about R80,000,000. This contract is of great value to Swaziland whose main income at present comes from its share of South Africa's customs revenue. This revenue is based upon an agreement established in 1910 and with the revision of these matters, which must take place before next May, the new arrangements may well not be as favourable to the Protectorate. The contract is also of significance to Anglo American which formed the company in 1958. Its financial importance is not great by comparison with its other activities but this is the first time that the group has had an interest in an iron ore proposition.

The deliveries under the contract are to start immediately after the completion of the rail link, this is scheduled for the end of 1964. The ore is to be shipped to Japan in three large ore carriers each of some 65,000 tons and it is expected that the ships will make the round trip to Japan in about 60 days. In order to accommodate the vessels the port at Lourenco Marques is to be deepened from 29 ft. to 35 ft. and the Portuguese authorities are building a new metal wharf which will handle between 1,000 and 1,500 tons of ore per hour.

The credit for the discovery of the deposits belongs to the Geological Survey of Swaziland, which made its valuable information available, and now after two years work the Development company's geologists have proved some 40,000,000 tons of ore and have found that there is the possibility of further tonnages. See *The Mining Journal*, August 26, 1960 p. 228, March 3, 1961, p. 250 and June 9, 1961, p. 675.

Yarra Falls.—A final dividend of 7.2d. (Australian currency) has been declared. This brings the total for the year to 1s. 2.4d. compared with 1s. 7.2d. for the previous year.

Wankie Colliery.—The preliminary figures show that the profit for the year ended August 31, 1961 was £1,532,373 before taxation. Although this is approximately £100,000 below the level of the previous year, a final dividend of 9d. per share has been declared thus maintaining the total payment at 1s. 3d. Taking no account of the £290,000 placed to general reserve in terms of the Coal Price Agreement, the dividend is covered 1.1 times.

Board Changes

Mr. E. T. S. Brown has been appointed a director of Anglo American Corporation of South Africa Ltd. Mr. Brown has been associated for many years with the South African diamond industry and with the common interests of the Anglo American Corporation and De Beers groups in the development of the marketing of industrial diamonds. He played an important part in the establishment of a diamond research laboratory, which in turn led to the discovery of a method of producing synthetic industrial diamonds. Mr. Brown is managing director of Industrial Distributors (1946) Ltd. He is also chairman and managing director of Boart and Hard Metal Products South Africa Ltd., and chairman of its sister companies in Canada and Europe.

Mr. K. C. Acutt, C.B.E., has resigned from the chairmanship of Wankie Colliery Co. Ltd. as he is now resident in England. He is remaining a director of the company. Mr. P. H. A. Brownrigg, D.S.O., O.B.E., has been elected chairman in his place. Mr. Brownrigg was appointed Director in Rhodesia of Anglo American Corporation of South Africa, Ltd. on July 1 of this year.

Sir Alexander Sim has been appointed a director of The Cementation Co. Ltd.

Mr. A. H. Ball has been appointed chairman of London and Rhodesian Mining and Land Co. Brig. S. K. Thorburn has resigned from the board owing to illness. Mr. R. W. Rowland has been appointed a director and joint managing director. Mr. H. L. Quinton ceases to be alternate director to Brig. Thorburn.

Mr. R. B. W. Bolland, formerly general manager of Head Wrightson Stockton Ltd., has been appointed London manager of Head Wrightson & Co. Ltd.

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Pensionable posts for qualified men as 3rd Class Valuers in the Mineral Section, which has offices in London, Birmingham, Leeds, Newcastle-upon-Tyne, and Cardiff. Age: at least 24 and under 34 on October 1, 1961; extension for candidates with regular Forces service or Overseas Civil Service. Qualification: Final examination of R.I.C.S., C.A. and E.A.I., or C.I.A.S., or B.A. (Cantab) or B.Sc. (Lond.) in Estate Management (preferably Final examination of R.I.C.S. in Mining subdivision) or 1st Class Certificate of Competency (Mine Managers); knowledge of mining subsidence and the principles of valuation of minerals; at least 4 years' experience of mining. Starting salary from £858 (24) to £1,258 (34 or over); scale maximum £1,430. Promotion prospects. For full details and application forms (which must be returned by October 17, 1961) write now to Mr. H. E. Knight, Department ML/C/2, Civil Service Commission, 6 Burlington Gdns., London, W.1.

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Applicants must hold degrees from recognized Universities and special consideration will be given to those with experience in the geology of iron ore deposits.

Applications in writing to Box No. 4293, c/o Charles Barker & Son Ltd., 20 Cannon Street, London, E.C.4.

Publications Received

Geology of the Country around Monmouth and Chepstow is the latest volume in the series of Memoirs of the Geological Survey of Great Britain, published by the Department of Scientific and Industrial Research. The district surveyed is included in 1-in. New Series Geological sheets 233 (Monmouth) and 250 (Chepstow), occupying a total of 432 sq. miles, of which some 46 sq. miles are covered by the Severn Estuary. This book is obtainable from H.M.S.O. price £1 2s. 6d.

Derwent Information Service has introduced a new publication, giving the English translation of the U.S.S.R. official bulletin of patents and inventions. A preliminary booklet has been issued, giving information on the Russian patent system, in order to give intending subscribers a chance to evaluate its probable usefulness. Included in the booklet is a guide on foreign patent procedure.

In the new edition of their publication *Electrical Contacts*, the publishers, Johnson, Matthey & Co., discuss the general considerations affecting selection of material and design of contacts. A range of metals and alloys have been developed by this company having the widest variety of characteristics to meet the innumerable requirements of all electrical equipment. The booklet, available from the company on request, gives detailed information and data on the JMC standard contact ranges.

U.S. Bureau of Mines research on explosives, explosions and flames during the period 1955-59 is summarized in three publications recently released, as Information Circular 7998 *Research and Technologic Work on Explosives, Explosions and Flames 1955-56*, price (30 c.); I.C. 7999, covering the years 1957 and 1958 (price 25 c.); and I.C. 8000, covering 1959 (price 30 c.). The first part of each circular discusses the principal explosion, explosives and flame-research programmes during the period covered, refers to companion publications and summarizes findings. The second part lists pertinent journal articles and Bureau publications prepared during the report period by scientists of the Bureau's Explosives-Research Laboratory at Pittsburgh and Bruceton.

Corrosion Resistance of Hot Galvanizing, the first in a new series of technical booklets to be published by the Hot Dip Galvanizers Association, may be obtained from the Association. It gives up-to-date information on the performance of hot galvanized coatings in contact with fresh and sea water, oils, chemicals, building materials and when used underground.

During periodic inspections of the uranium occurrences in North-Western Queensland for five years Mr. J. H. Brooks, author of the Geological Survey of Queensland's publication No. 297, *The Uranium Deposits of North-Western Queensland*, has amassed a wealth of detailed information on this important uranium province. Part I of this paper deals generally with the geology of the deposits, and Part II contains detailed descriptions of all the more important known occurrences. A feature which emerges is the persistent occurrence of uranium mineralization over a very wide area, and it is believed that further investigation may show some of the known prospects to be of commercial significance. This report has been published by the Queensland Department of Mines.

The Department of Scientific and Industrial Research, in the latest issue of their geological survey of Great Britain, *Economic Geology of the Fife Coalfields Area II*, have covered the Cowdenbeath and Central Fife area, including Fordell, Lochgelly, Cadham and Kirkcaldy. The area comprises about 102 sq. miles of ground occupied mainly by strata of Lower Carboniferous age. It was originally surveyed by (Sir) A. Geikie and H. H. Howell, the examination of the southern portion being carried out in 1858 and that of the northern and main portion in 1861. The present Memoir has been written by Mr. J. K. Allen and Mr. J. Knox, who have in addition prepared a sheet of comparative vertical sections to illustrate the succession in different parts of the area. The main structural feature is the Burntisland anticline, which can be traced from the coast at Burntisland, inland in a N.N.E. direction to near Markinch, and separates the Cowdenbeath and Lochgelly coalfields on the west from Kirkcaldy coalfield on the east.

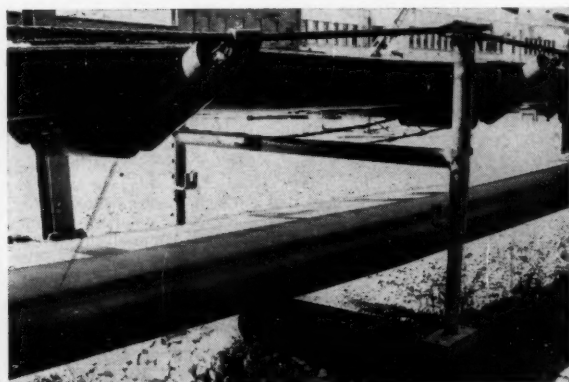
The Northern Rhodesian Ministry of Labour and Mines Geological Survey's Report No. 9, entitled *The Geology of the Sinda Area*, by K. A. Phillip, is the first of a series of reports covering a hitherto unmapped region in the Eastern Province. It describes one portion of a pluton, the full extent of which is at present unknown. The area lies on the Mozambique border, and at this early stage in the regional mapping programme, the report is intended to be descriptive rather than conclusive. The report may be obtained from the Ministry of Labour and Mines in Lusaka, price 15s.

Abstracts of papers presented at the 1st International Congress of Metallic Corrosion in April last form an interesting feature of a recent issue of *The Nickel Bulletin*, published by The International Nickel Co. (Mond), Ltd. A data sheet is included in this issue, which outlines the properties of a new 18 per cent nickel-cobalt-molybdenum "mar-aging" steel, developed by Inco, which is capable of exhibiting a yield strength in excess of 110 tons/sq. in., while maintaining a nil-ductility temperature below -60 deg. C.

A brochure entitled *Statistical Review of the World Oil Industry 1960*, which tabulates, with supporting diagrams, the 1960 and previous statistics of world oil reserves, production, consumption, supply and demand, refining, tanker shipping and energy, has been produced by BP. All oil statistics in this new edition are presented in both tons and barrels. There is also an historical section which gives brief details of the main sectors of the industry over the past ten years. A limited number of copies of this brochure is available on application to the company's London office. (Telephone: NATIONAL 1200, (Ext. 542).)

The Somaliland Ministry of Natural Resources has published the third of a series of pamphlets, with the aim of making up-to-date information on the territory's mineral resources available as quickly as possible. The latest volume *Minerals and Rocks of Hargeisa and Borama Districts* by J. L. Daniels, obtainable at the Ministry in Hargeisa, price 4s., is concerned with the west of Somaliland. Some new mineral finds and several new localities for minerals are described. Suggestions for further investigations are made.

A Bibliography of Cyprus Geology, compiled by L. M. Bear, has been issued by the Geological Survey Department, P.O. Box 809, Nicosia, Cyprus. It represents the first attempt to compile a comprehensive bibliography of Cyprus geology. Papers dealing with closely-related subjects such as mining, underground water and soils are also included, if sufficient reference to the geology is given. The list also contains titles of unpublished reports, such as departmental reports, (reports some confidential) to exploration and mining companies, reports received from the Mineral Resources Division of the Overseas Geological Surveys, and unpublished University theses.



Prototype of the dual purpose rope side framed conveyor structure put into production by Distington Engineering. In our issue last week this illustration was mis-printed. The Distington - Goodman ropebelt rope side-framed conveyor structure is still developing, emphasis being to improve quality and reduce costs

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Coal Equipment in India

A licence has been issued to a new company under the name of McNally-Bird Engineering to manufacture coal washeries as well as coal-handling plants in India. This enterprise will be based on joint Indo-British-American collaboration. "McNally" in the name stands for McNally Pittsburg Manufacturing Corporation, U.S., and "Bird" for Bird and Company (Private) Ltd., Calcutta. Its authorized capital will be Rs. 20,000,000 and the major portion of the finance, it is stated, will be provided by the American partners. The company proposes to manufacture 70 per cent of a coal washery from the beginning and to achieve 100 per cent indigenous content in about five years. Its plant will be located at Kumardhubi in Bihar and is expected to go into production in about a year's time with a manufacturing capacity equivalent to producing coal washeries aggregating 1,000 tons p.h.

Preliminary steps for setting up two major projects for coal development in the district of Dhanbad in Bihar have

been taken by the National Coal Development Corporation.

The N.C.D.C. has started work to reopen the abandoned Sudamdih Colliery, which is believed to have a reserve of nearly 250,000,000 tons with an ash content of 10 to 28 per cent, the highest grade of coal available in India. The N.C.D.C. will work there in collaboration with a Polish firm, CEKOP.

According to an agreement with the N.C.D.C., the Polish firm will prepare a project report for the Sudamdih Colliery, about 12 miles from Dhanbad, and an incline with the common surface plant. The surface equipment will include a coal washing plant besides a workshop, coal bunkers, etc.

The planned output of raw coal from the mines is 7,500 tons per day. The area of the colliery is spread over in 1.75 miles along the strike and nearly a mile along the depth. The area consists of 14 coal seams of varying thicknesses of 4 to 60 ft. with a total reserve of nearly 250,000,000 tons.

